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Chionanthus virginicus

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Arboretum Activities

The Staff

On Friday, February 12, the Director addressed the annual meeting of the Pennsylvania Nurserymen's Association at the Warwick Hotel. The subject of his lecture was "Plant Exploration in Southeastern Asia." On February 17, he spoke to the Society of Little Gardens of Philadelphia on the topic, "A Botanist in India."

Dr. Li gave an illustrated lecture to the Garden Workers in Ardmore on January 18. His talk was entitled "The History of the Japanese Gardens." On March 22, he spoke to the Four Counties Garden Club on "Japanese Gardens and their Plants" and on March 24 he addressed the Philadelphia Botanical Club on the topic, "A Trip to the Far East — Hong Kong, Formosa and Japan."

On January 13, Dr. Allison spoke to the Wyoming Valley Garden Club at Wilkes Barre, Pennsylvania, on "Dividends from the Fungal World," and on March 1, she gave an illustrated lecture entitled "Fungal Jungle" to the members of the Comstock Society.

Horticultural Society Award

At the Spring Luncheon of the Pennsylvania Horticultural Society, held on Tuesday, March 8, the Morris Arboretum was given the Society's Certificate of Merit Award, "In recognition of outstanding service to the community and the individual, through research, education and display in the field of horticulture."

(*Continued on page 6*)

Chionanthus in the Philadelphia Area

John M. Fogg, Jr.

One of the most attractive tall shrubs or small trees to bloom in this area during mid to late May is *Chionanthus,* known commonly as Fringe-tree or Old-man's beard. This genus belongs to the Oleaceae or Olive Family which in addition to the olive of commerce, includes the lilacs (*Syringa*), the privets (*Ligustrum*), the ashes (*Fraxinus*), the jasmine (*Jasminum*), and the Forsythias.

The flowers of the Fringe-tree are borne in panicles which are either pendant or somewhat spreading. The whitish corollas are composed of four extremely narrow petals which are free nearly to the base, imparting to the inflorescence the appearance of a fine mass of snowy tinsel.

All species of *Chionanthus* are reputed to be dioecious, or at least functionally so. The male flowers bear two stamens with a small, abortive or functionless ovary between them .The female flowers have an ovary, with a well developed stigma, and a pair of anthers, but the cells of the latter are reported as usually remaining closed. However, Rehder (1904), after studying this situation, came to the conclusion that plants of *Chionanthus* are pseudo-monoclinous and Wilson and Wood (1959) refer to them as polygamo-dioecious, that is, chiefly dioecious but occasionally with bisexual and unisexual flowers on the same plant.

Most authors agree that the petals of male flowers are longer and narrower than those of the female.

The fruit of the Fringe-tree is an ovoid dark blue or purplish drupe which lends added interest to the plants in late summer and autumn.

The opposite leaves are simple and vary in shape from ovate-lanceolate to elliptic or oblong. They assume a bright lemon-yellow color in the fall providing an attractive contrast with the bluish fruits. In the spring the flowers and leaves develop simultaneously, so that the latter form a green background for the feathery appearance of the former.

In Rehder's Manual two species of *Chionanthus* are recognized as being in cultivation in this country: *C. virginicus* L., [1] a native of eastern North America and *C. retusus* Lind. & Paxt., which occurs in China, Korea and Japan.

[1]Although the names of most genera of trees are feminine, an exception exists in the case of those which end in "anthus."

The American Fringe-tree

The common American Fringe-tree, *C. virginicus,* occurs naturally from southern New Jersey and southern Pennsylvania to Missouri, Oklahoma, Florida and Texas. It is, however, cultivated far north of its natural limits of distribution.

It is a tall shrub or small tree, up to 10 meters, (about 30 feet) usually found in acid soils in swampy woods, along stream banks or on rocky bluffs. The large oval to obovate or lanceolate leaves are dark green and lustrous above, somewhat paler beneath, and turn a bright yellow color in the autumn.

The flowers are borne in loose, gracefully drooping panicles and the narrowly linear, pure white petals are from 2 to 3 cm. long. (Fig. 1).[2] The number of petals, although characteristically four, may be as many as five or six, especially in the staminate flowers. The purplish or bluish drupes are about 2 cm. in length.

Fig. 1. *Chionanthus virginicus* showing inflorescence.

Typical *C. virginicus* has the mature foliage and inflorescences essentially smooth. However, there is a form occasionally found in cultivation in this area in which the under surfaces of the leaves and the branches of the panicles are decidedly hairy or pubescent. This is apparently what has been called var. *maritimus* Pursh (var.

[2]Photographs by Dr. H. L. Li.

Fig. 2. *Chionanthus virginicus.*
Plant on slope below Baxter Memorial.

pubescens Dipp.) One such specimen at the Morris Arboretum has leaves which are narrower and more pointed at the apex than is the case with typical *C. virginicus.* It is obvious that this species is extremely variable and is in need of further detailed study.

In our region the American Fringe-tree generally blooms between May 15 and 20, and retains its flowers for a week or ten days, depending upon the weather. When fully out it eminently deserves its generic name (from *chion,* snow, and *anthus,* flower). Whether grown as an isolated plant (Fig. 2) or grouped together against a background of taller vegetation (Fig. 3) it is richly entitled to a place in any collection.

It is gratifying to record that this species is widely cultivated in the Philadelphia area and that its popularity appears to be increasing steadily.

Another American species, *C. pygmaeus* Small, is a low shrub, spreading by underground stems, with petals about 1 cm. long. It is restricted to the lake region of central Florida where it occurs on scrub ridges and sandhills. (Small, 1933).

In Barton's Flora Virginica (1812) there appears a reference to *C. rosea* with the following comment, "I am assured that Mr. Clayton discovered in Virginica, and cultivated in his garden, a species, or variety of Fringe-tree, with rose-coloured blossoms. I presume it was nothing but a variety of the common Chionanthus virginica: and it is said that similar specimens of this shrub have been observed in other parts of the United States." For a fuller discussion of Barton's Flora see Pennell (1926).

While a pink-flowered Fringe-tree would be a distinct and valued addition to eastern American horticulture, we have no information concerning the existence of this variety either in the wild or in cultivation.

The Oriental Fringe-tree

The Oriental or Chinese Fringe-tree, *C. retusus,* is smaller in most respects than its American congener. It is seldom more than 5 to 6 meters (16 to 20 feet) in height and its leaves are usually much shorter than those of *C. virginicus.* The panicles are borne at the ends of lateral shoots and are nearly horizontal, whereas those of the American species are drooping (Fig. 4). Also, the petals are shorter and slightly wider than those of our plant and the species blooms from three or four days to a week later. Most persons who know the two are inclined to believe that the American form is the more showy.

As might be expected in a species with such a wide geographical range, *C. retusus* is also extremely variable, especially with respect to the size and shape of the leaves.

The specific name *retusus* is generally applied to plants in which the leaves are shallowly notched at the apex. Although none of our plants possesses foliage of this kind, there are several specimens growing at the Arnold Arboretum in which the leaves are distinctly retuse. Fig. 5 is a photograph of an herbarium specimen of such a plant which I collected there in October, 1958. Mr. A. J. Fordham, the propagator at the Arnold, has

Fig. 3. *Chionanthus virginicus.*
Group of plants in Oleaceae section.

Fig. 4. *Chionanthus retusus.*

promised to send us rooted cuttings of this material.

Most of the specimens of *C. retusus* which we have seen in cultivation in our area have leaves with broadly rounded apices. Unfortunately, too little is known about the geographic origin of these plants to permit of any correlation between leaf-shape and distribution in the wild.

Still another variation may be seen in the character of the leaf margin. Several years ago we received from the Taylor Arboretum two specimens of *C. retusus* in which the leaves were finely but sharply serrulate (Fig. 6).

These differed markedly from other plants in our collection in which the leaf-margins were entire. A search through the literature revealed the fact that Hayata (1913) had described a new species from Formosa which he named *C. serrulatus,* adding that in the Tokyo Herbarium there is another specimen of this species from the mainland of China. Koidzumi (1925) reduced this to a variety of *C. retusus* and Rehder and Wilson (1927) stated that they consider it merely a juvenile form of this species, affirming that young plants of *C. retusus* always have serrulate leaves.

We can not establish the age of the plants which we received from the Taylor Arboretum, but they are about 2 meters tall and have produced flowers. Furthermore, at the Arnold Arboretum there are several mature specimens in which the leaves are distinctly serrulate. It is thus difficult to accept the suggestion that serrulate leaf margins are inevitably associated with young growth. We are therefore labeling our plants *C. retusus* var. *serrulatus* and at the same time recognizing that here again, as with *C. virginicus,* a tremendous amount of careful morphological and genetical work is required to bring about a better understanding of this complex population.

According to Rehder (1940), *C. retusus* was originally introduced into cultivation in 1845 and reintroduced in 1879. Although less widely planted in our area than its American relative, it is nonetheless a highly desirable shrub. Its somewhat wider and pure white petals lend greater substance to the panicles and its habit of flowering slightly later and remaining in bloom rather longer than *C. virginicus* renders it a valuable supplement to that species.

At the Morris Arboretum we have planted the two species in close proximity in a newly developed area, near the Langstroth Bee Garden, in which we are bringing together all hardy members of the Olive Family. In the background

Fig. 5. *Chionanthus retusus.* Form with notched leaves.

Fig. 6. *Chionanthus retusus* var. *serrulatus*.

we have massed mature specimens of the taller American Fringe-tree and in front of them are the lower more horizontal plants of its cousin from the Far East.

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Arboretum Activities

(*Continued from Page 2*)

New Plantings

As usual, much of our activity during late autumn and early winter was devoted to moving plants from our nurseries to their permanent positions on the grounds. The major area involved at this time is the 70 acre tract formerly known as Bloomfield which lies to the north of Northwestern Avenue.

Here will be located the "home" of such important families as Berberidaceae, Saxifragaceae, Rosaceae, Leguminosae, Oleaceae, and Caprifoliaceae. Room is also provided for several smaller and less spectacular groups, such as Rutaceae and Rhamnaceae.

Mass plantings have already been started of *Malus, Prunus, Syringa, Ligustrum, Chionanthus, Forsythia, Lonicera* and *Viburnum*. A basic planting of *Rhamnus* has been established and the Rutaceae is represented by several species of each of the following: *Phellodendron, Evodia* and *Zanthoxylum*.

Cherry Row

Of special interest to our visitors this spring will be a newly planted double row of Oriental cherries along the lower roadway which extends from the wooden bridge westward to the native azalea area. Formerly this road was flanked by a row of hawthorns on one side and a row of lilacs on the other. The hawthorns have been badly afflicted by disease which has necessitated their removal and the lilacs are, for the most part, outmoded varieties which have been replaced by better material.

The new planting includes some forty young trees representing three species and fourteen forms which have been carefully selected to demonstrate both single and double flowers ranging from white to deep pink. Following is the list of species and cultivars with their common names:

Prunus Sieboldii	Naden Cherry
P. serrulata	
albo-rosea	'Shirofugen'
contorta	'Fukuroki'
fugenzo	'Fugenzo'
hatazakura	'Hatazakura'
Kwanzan	'Kwanzan'
Meigetsu	'Meigetzu'
moutan	'Botan-zakura'
nobilis	'Akebono'
ojochin	'Ojochin'
oshibayama	'Oshibayama'
yubida	'Benden'
senriko	'Senriko'
shirotae	'Mount Fuji'
versicolor	'Yae-akebono'
P. yedoensis	Yoshino Cherry

Plant Distribution Days

The practice of making our annual distribution of plants to our Associates in the spring, rather than in the autumn, proved so popular last year that we are repeating it.

The dates which have been selected are Friday and Saturday, May 20 and 21. Prior to this event our associates will receive individual announcements together with a list of the material which will be available.

J. M. F., Jr.

Western and Southern Oaks in The Michaux Quercetum

Frank S. Santamour, Jr.[1]

The Michaux Quercetum is a joint project of the Morris Arboretum of the University of Pennsylvania and the Northeastern Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, financed in part by the Michaux Fund of the American Philosophical Society. One of the aims of this project, as outlined by Schramm and Schreiner[2] is to provide preliminary tests on the adaptability of exotic oak species to the Philadelphia region. As a start 74 individual seed collections of oak species native to the western and southern United States were planted during 1953 and 1954. Acknowledgments to cooperators who assisted in this work have been made in previous reports.[2, 3]

Seed collections of about 100 acorns were made from individual trees in the South and West. Two replicates of the acorns of each species were planted in the late fall in special seedbeds designed for maximum protection against rodent damage. Seedlings that developed from acorns planted in the fall of 1953 suffered only negligible damage from rodents. However, in spite of the protective measures, seedlings from the 1954 sowing were almost 100-percent topped by rabbits during the winter of 1955-56. None of the 1954 seedlings of the less hardy southern and western species survived the combination of animal damage and the more severe climate of the Philadelphia area. Thus, data for these species include one-year height growth for seedlots in both years of planting, but survival and dieback are reported only for those seedlots planted in 1953.

The seedlings were transplanted to rows in the nursery area before leafing out the second spring. Winter mortality was investigated after the trees had begun to grow; thus mortality due to transplanting was confounded with winter-killing. However, since Li[3] pointed out that the average first-year mortality for eastern and northern species was almost 5 percent, it has also been assumed that any figure beyond this, even for southern and western species, can be interpreted as due to winter-killing.

Observations made for three years on the oak species indigenous to the western and southern United States will be discussed in alphabetical order. Data on seedling survival were taken in the spring of the third growing season.

Western Oaks

Quercus agrifolia Née, the California or coast live oak, is a native of the Coast Ranges of California south to Baja California, Mexico. The specific name *agrifolia* (literally field-leaved) probably originated as a printing error for *acrifolia* (sharp-leaved) or *aquifolia* (hollyleaf), for the leaves are persistent for one year and may have the spinose teeth characteristic of *Ilex*. The three collections of this species were from areas 750-1,500 feet in elevation where the growing season ranged from 220 to 331 days. Germination ranged from 82 to 90 percent, and the average first year growth of 31 cm. was among the best for all oak species. However, after the first winter 95 percent of the seedlings were dead, and the remaining trees had suffered some dieback. None of these trees survived the second winter.

Quercus chrysolepis Liebm., canyon live oak, is another native of the Coast Ranges from southern Oregon to Baja California and also occurs on the western slopes of the Sierra Nevada. A somewhat shrubby form. var. *Palmeri* (Engelm.) Sarg., is found in New Mexico, Arizona, southern California, and Baja California. The evergreen leaves are dimorphous, being either hollylike or with nearly entire margins. The two collections came from regions between 2,200 and 6,025 feet in elevation. The average first-year height was 14 cm. and there was no real difference between sources. Two collections of var. *Palmeri* from California averaged 18 cm. in height for the first growing season. Only one seedlot of the species was planted in 1953, and two seedlings survived the second winter.

Quercus Douglasii Hook & Arn. is known generally as blue oak. Other common names such as western white oak and mountain white oak are misnomers, since the species is now considered to belong to the red oak group. The deciduous leaves of this species may be oval and entire or lobed. The six collections in the Quercetum were all from the species' restricted range in the foothills of the California Coast Ranges from 900 to

[1]The author is a geneticist on the staff of the Northeastern Forest Experiment Station, U. S. Forest Service. He is stationed at the Morris Arboretum of the University of Pennsylvania, where the Experiment Station and the Arboretum cooperate in genetics research.

[2]Schramm, J. R., and Schreiner, Ernst J. 1954. The Michaux Quercetum. Morris Arboretum Bulletin 5: 54-57.

[3]Li, Hui-Lin. 1955. A progress report on the Michaux Quercetum. Morris Arboretum Bulletin 6: 45-47.

2,300 feet. First-year growth averaged 17 cm. Germination of the two seedlots sown in 1953 was 81 percent, and, although most of the seedlings succumbed or suffered dieback during the first winter, 25 trees were still alive after the second winter. Although this species may reach heights of 50 to 80 feet, its low-quality wood makes it undesirable as a forest tree.

Quercus dumosa Nutt. is usually a small shrub 3 to 10 feet high, and it well deserves the common name of California scrub oak. However, it sometimes becomes a small tree is parts of its range from northern California to Baja California. Five seedlots of this species, grown in the Quercetum, had an average germination of 78 percent and a first-year height of 21 cm. Twenty-five seedlings of the three seedlots planted in 1953 survived two winters, but they suffered considerably from dieback.

Quercus durata Jeps., the leather oak, is sometimes known as *Q. dumosa* var. *bullata* Englem. It is a shrub with a more restricted range than *Q. dumosa*. Its shrubby nature is reflected in the average first-year height of 12 cm. No trees of the five seedlots of this species survived two winters in Philadelphia.

Quercus Gambelii Nutt., the Gambel or Rocky Mountain white oak has a range that takes in parts of most of our southwestern states. All of the five collections in the Quercetum (two each from Colorado and Utah and one from Arizona) are from elevations over 7,000 feet. It is a slow-growing species commonly 20-25 feet tall, and after the first year in the nursery it averaged only 8 cm. in height. The Colorado and Utah seed collections were from areas of more severe climate than that of Philadelphia, and survival for all seedlots was between 22 and 25 percent after two years.

Quercus Garryana Doug. is known as the Oregon white oak, although its range extends from southern British Columbia south to around San Francisco, California. This species is seldom more than 50-70 feet in height, and it generally has poor forest form. The seven seedlots in the Quercetum (two each from Washington and Oregon and three from California) were collected from elevations between 225 and 1,700 feet. The two Washington collections planted in 1953 are a good example of the variation between trees of the same species in transmitting vigor to their offspring. Although the trees from which the seed was collected were only 1½ miles apart along the same road the one-year-old seedlings from one tree averaged 22 cm. in height, while seedlings from the other tree were only 8 cm. tall. Two-year survival was 31 and 34 percent for the Washington collections and 16 percent for the single California seedlot planted in 1953.

Quercus Kelloggii Newb., the California black oak, has a range that extends from the Mackenzie River in Oregon south in the Coast Ranges to San Diego County, California, and it is also found in the Sierra Nevada. This is a slow-growing species, and it is usually of inferior form over most of its range. Three collections of this species were made in California and four in Oregon from altitudes between 450 and 2,000 feet. The single California seedlot planted in 1953 had an average first-year height of 43 cm., whereas the two Oregon seedlots planted the same year averaged only 18 cm. The height of this California collection was the best for all seedlots in the Quercetum. Seedlings of California origin were also taller than those from Oregon in the seedlots planted in 1954, but the difference was less marked.

The California seedlot was from an area in Monterey County with an average January temperature of 50° F. and a growing season of 250 days. The Oregon seedlots were from Josephine County, where the climate was more severe, with an average January temperature of 36° F. and a 155-day growing season. One might have expected that the Oregon seedlings would be less affected by the Philadelphia winter, but this was true only for the first year. Thirty percent of the California seedlings died during the first winter and 62 percent showed signs of dieback, while only 18 percent of the Oregon trees were dead and 19 percent had died back. However, after the second winter, only 16 percent of the seedlings from Oregon were still alive as compared to 69 percent survival of the seedlings from California. This difference may be due to the large root system built up by the California trees, which enabled them to sprout vigorously even after the stem had been killed back for a considerable length.

Quercus lobata Née, the California white or valley oak, is truly the king of the western species of *Quercus*. It is a fast-growing tree and is commonly 90-125 feet in height with a diameter of 3 to 5 feet. The crown is usually wide-spreading, and an open-grown tree has the appearance of the familar English oak (*Q. robur*). For all its magnificence, however, it is of little utility to man, for the wood is not of the best quality. This species occurs only in California, generally in the foothills of the Sierra Nevada. The five collections in the Quercetum are from areas of 500 to 1,000 feet in elevation. First-year growth averaged 36 cm. First-year mortality was 32 percent, and dieback occurred on 33 percent of the trees. Survival after the second winter was 50 percent for the three seedlots planted in 1953.

Quercus Sadleriana R. Br., the deer oak, occurs from southern Oregon through the Sis-

kiyou and Klamath Mountains to Trinity County, California. Both collections in the Quercetum are from Trinity County, California, and they were planted in 1954. First-year height averaged 8 cm.

Quercus turbinella Greene, the shrub live oak, is sometimes regarded as a variety of *Q. dumosa.* This species seldom is more than 15 feet tall, and the one-year-old seedlings of three seedlots averaged 11 cm. in height. The two seedlots from California planted in 1954 were lost, but two seedlings of a seedlot from Arizona planted in 1953 survived two winters.

Quercus vaccinifolia Kellogg, the Huckleberry oak, is sometimes considered a variety of *Q. chrysolepis.* It is a shrubby species, and the two seedlots from California planted in 1954 averaged only 6 cm. in height at the end of the first year.

Quercus Wislezeni A. DC., the interior live oak, is similar in many respects to the coast live oak, *Q. agrifolia.* However, as evidenced by their common names, the two species seldom meet in nature. The range of *Q. Wislezeni* is from Mt. Shasta south along the inner Coast Ranges and the Sierra Nevada to Baja California. Although it is generally shrubby in habit, it may reach heights of 60-80 feet under optimum conditions. First-year growth in the nursery averaged 21 cm. for the seven collections in the Quercetum. Like its coastal counterpart, this species did poorly in the Philadelphia region. In the three 1953 seedlots, 96 percent of trees were dead or had died back after the first winter, and none survived the second.

Collections were also made of *Q. grisea* Leibm. (gray oak), *Q. hypoleucoides* A. Camus (silverleaf oak), and *Q. oblongifolia* Torr. (Mexican blue oak) from Arizona. These seedlots failed to germinate.

Southern Oaks

Quercus Chapmanii Sarg. is called the Chapman oak. It is a little-known species occurring in the coastal plain from southeastern South Carolina to southern Florida. First-year growth of the single Florida collection was only 6 cm., and 92 percent of the trees were dead or had died back after the first winter. No trees survived two winters in Philadelphia.

Quercus incana Bartr. includes *Q. cinerea* Michx. and is known as the bluejack oak. This species inhabits the coastal plain from Virginia to Texas and is also found north to Oklahoma. Two collections from Texas were included in the Quercetum. First-year growth was 21 cm., and although mortality and dieback during the first winter was extremely severe, 19 seedlings were still alive at the beginning of the third growing season.

Quercus laevis Walt. is called the turkey oak and is found along the coast from South Carolina to Florida, where it also occurs on the interior sand hills. This species is a small tree of no commercial importance. The single Quercetum collection from Florida was planted in 1954 and had a one-year height of 8 cm.

Quercus myrtifolia Willd., the myrtle oak, is also a native of the southern coastal plain. The single collection from Florida averaged 8 cm. in height the first year. Seventy-two percent of the trees died during the first winter and none survived the second.

Quercus Nuttalli Palmer, the Nuttall oak, has been known as a distinct species only since 1927. Its range is not well known although it occurs in the bottomlands of the lower Mississippi Valley and also is Alabama. The species can be seperated from pin oak (*Q. palustris*) and scarlet oak (*Q. coccinea*) by characteristics of the fruit. In its native habitat Nuttall oak may reach heights of 100-120 feet in virgin stands, and in the nursery the seedlot from Mississippi averaged 41 cm. in height the first year. There was no mortality the first winter, although 37 percent of the trees had some dieback. Survival after two years was 93 percent.

Quercus pumila Walt. is known as the running oak and has been considered a variety of *Q. cinerea* Michx. by some authors. This species is another native of the coastal plain and sandhills from North Carolina to Mississippi. A single seedlot from Florida was planted in the Quercetum in 1954 and the first-year height averaged 14 cm.

Quercus virginiana Mill., the live oak, is the only important "evergreen" oak of eastern North America. The leaves, which are usually entire, persist until the following spring. The heavy, strong wood of this species made it extremely important in the shipbuilding of the early United States. This species is found along the coastal plain from Virginia to Texas. It occurs also in Mexico. Three seedlots (two from Virginia and one from Florida) were included in the Quercetum and the first-year height of 5 cm. was among the lowest for all oaks. Mortality during the first winter was extremely high, and no trees survived the second winter.

Discussion

It appears that the oak species from the western and southern United States which have been studied in the Quercetum have very little future as ornamentals or forest trees in the Northeast. The evergreen or live oaks simply cannot survive the rigorous winters in sufficient numbers to justify their use. The rest of the species, which have little ornamental value, also have growth and wood characteristics that are generally in-

ferior to native northeastern species. One possible exception is *Q. Nuttalli,* which should be investigated further.

ACKNOWLEDGMENTS

The Michaux Quercetum has been a truly cooperative project since its inception. Personnel of the Morris Arboretum of the University of Pennsylvania, originally supervised by former director, J. R. Schramm, and now under the direction of John M. Fogg, Jr., have been responsible for nearly all the contacts with seed collectors and most of the nursery work. H. L. Li and Mary O. Milton have handled the accession records and herbarium specimens.

The measurement and evaluation phases of the project are under the direction of Ernst J. Schreiner of the Northeastern Forest Experiment Station, U. S. Forest Service. David Hammond of the Arboretum staff and Ernst J. Schreiner, W. J. Gabriel, H. C. Kettlewood, and the author, all members of the Northeastern Station staff, have participated in measurement and evaluation of data at various times. In addition, Jonathan W. Wright, formerly with the Station and now on the staff of Michigan State University, made some of the measurements on this project.

Note: All individuals of *Q. Douglasii, Q. dumosa, Q. Gambelii, Q. Garryana, Q. incana, Q. Kelloggii, Q. lobata,* and *Q. turbinella* that had survived three years in this area were lost during the dry summer of 1957 because of inadequate watering facilities at a cooperating nursery. *Q. Nuttalli* has been outplanted at Longwood Gardens.

Associates' Corner

AROUND THE WORLD AT THE ARBORETUM

No passports are required. You do not even have to be vaccinated. The library at the Arboretum is situated in a bright, sunny room with a large reading table and comfortable chairs. One generally thinks of arboretum libraries as shelves filled with technical books of reference and, although the Morris Arboretum has an outstanding collection of these, it also offers a vast assortment of literature of great interest to the layman.

Our library is one of 30 affiliated and departmental branches of the library system of the University of Pennsylvania. Although there is no full-time librarian here, Miss Elizabeth Shinn, of the Cataloguing Division of the Main Library, visits the Arboretum about once a month and keeps our catalog and shelf-list in perfect order.

The Arboretum has a verifax machine which enables it to copy paragraphs or pages from any book or pamphlet. Requests for data and information from all parts of the world make this device of great value. There also exists a system of inter-library loans with other organizations.

As in the past, the December issue of the Bulletin contained a selected list of books added throughout the year to the library. Hope you kept it.

When new books, journals and articles arrive they are put on Dr. Fogg's desk. After he has perused them (Heaven knows when he gets time) he attaches to each a printed slip headed "Please check and circulate." Only after the item has been seen by every member of the staff is it placed in its appropriate spot on the library shelves.

Incidentally, the Arboretum receives botanical and horticultural periodicals from every section of the United States and many foreign countries. Most of these are received in exchange for this Bulletin which is sent all over the world.

To give you an idea of the tremendous geographic coverage of the library some of the basic floras include: Reichenbach's "Icones Florae Germanicae," Coste's "Flore de la France," Hooker's "Flora of British India," Ridley's "Flora of the Malay Peninsula," Standley's "Trees and Shrubs of Mexico," Macbride's "Flora of Peru," and many more. Also many books on Trees and Shrubs of the United States and foreign parts, general gardening, rock and water gardens and house plants.

One whole section consists of books on Landscape Architecture and on the gardens of the United States, England, France, China, Japan, etc. The Associates' dues help materially toward enlarging the library, and members are welcome to browse, borrow, or avail themselves of the copying service.

Recently I had a lovely trip through Portuguese gardens with a beautifully illustrated book, sitting in the nice warm library while the snow fell and the wind whistled outside. Afterwards I went into the jungles with a book on Plant Exploration. We are indeed privileged to have such a splendid resource so accessible. The library is a fascinating place and I highly recommend a fireside trip in it, or if you are planning a trip some familiarity with the vegetation you will encounter will greatly enhance your tour.

MARION W. RIVINUS

Flower Show Exhibit

John M. Fogg, Jr.

Upon invitation of the Pennsylvania Horticultural Society the Morris Arboretum arranged an exhibit of ivies for display in the Philadelphia Flower Show which was held during the week of March 7.

The Arboretum's collection of ivies has long been recognized as one of its most distinguished assets. The entire issue of our Bulletin for May, 1956,[1] was devoted to an illustrated article on these plants by Dr. George H. M. Lawrence, an eminent authority on the genus *Hedera*. In speaking of the problem of keeping separate the different clones of ivy, Dr. Lawrence has this to say: "This difficulty has been resolved at the Morris Arboretum by growing each kind on separate trees of a very beautiful double row of oaks. This collection, started there in 1945, is the best outdoor display of ivy clones known to me anywhere in this country or in Europe."

It therefore seemed highly appropriate to us that in mounting our exhibit we should attempt to convey an impression of the manner in which our ivies are grown at the Arboretum. We were extremely fortunate in engaging the services of a young Philadelphia artist, Mr. Christopher Davis, to paint a picture of "Oak Avenue," portraying the double row of oaks with ivies growing on their trunks. This painting, which was 20 feet long and 9 feet high, provided an effective and realistic background for our display of living plants. (Figs. 7, 8 and 9).[2]

Incidentally, Mr. Davis, in addition to being an artist is also a writer and a teacher. His novel, "Lost Summer", was recently made into a play entitled, "There was a Little Girl," which enjoyed a successful run in Philadelphia during February.

Although not in competition, our exhibit was awarded the coveted Bulkley Medal of the Garden Club of America, an honor in which every member of the Arboretum family takes the greatest pride.

The citation which accompanies this medal reads as follows:

"The Bulkley Medal of the Garden Club of America is awarded to an exhibition of ivies by

[1]Volume 7, No. 2: 19-31.

[2]Photographs by E. B. Gilchrist, Jr.

Fig. 7. General view of exhibit.

Fig. 8. Detail of exhibit.

the Morris Arboretum of the University of Pennsylvania.

"An interesting collection of the many forms of *Hedera Helix*, cleverly staged against an appropriate background suggesting the habit of growth at the Arboretum.

"An outstanding demonstration of distinction, clearly labeled, and with an educational legend, makes this an exhibit of special merit."

Although nearly every member of our staff had a hand in this undertaking, a major portion of the credit for its success must go to our Superintendent, Mr. John Tonkin, who for several months devoted himself assiduously to the assembling, preparation, and arrangement of the living material.

An attractively mounted rustic sign accompanying our exhibit bore the following legend:

"Displayed in this exhibit is a reasonably complete collection of the many cultivated forms of *Hedera Helix* or English Ivy, together with representatives of three additional species: *H. canariensis*, Algerian Ivy; *H. colchica*, Colchican Ivy; and *H. rhombea*, Japanese Ivy. A bigeneric hybrid, *Fatshedera Lizei*, is also on display, along with the two parental species, *H. Helix* and *Fatsia japonica*.

"English Ivy provides a striking example of the origin of garden forms by mutation and selection. The numerous forms are widely used as climbers or ground covers, or grown for indoor decoration. While some, particularly the varieties of *H. canariensis*, are primarily grown as house plants, most of the others have proved hardy as outdoor plants at the Morris Arboretum, where a permanent outdoor collection is maintained as depicted on the background panel of this exhibit."

The following 85 varieties or cultivars of *Hedera Helix* were included in our display:

Alice Fletcher
Albany
var. *baltica*
Big Leaf Variegated
Big Deal
Bulgaria
Buttercup
California
Cavendishii
Cordifolia
Crested
Curly Leaf
Deltoides
Digitata
Discolor
Elegantissima
Emerald Gem
Emerald Jewel
Erecta
Fan
Fanette
Fluffy Ruffles
Garland
Glacier
Glymii
Gold Dust
Good Self-branching
Gracilis
Green Crown
Green Quartz
Green Ripple
Green Spear
Hahn's
Hahn's Variegated
Heleri
var. *Helix*
Helvetica
var. *hibernica*
Holly
Ideal
Jubilee
Lace Leaf
Long Point
Maculata
Manda's Crested
Maple Queen
Marshall
Meagherii
Merion Beauty
Minima
Mrs. Pollock
Ontario
Parsley
Patricia
Pedata
Pin Oak
Pittsburgh
Pixie
Rambler
Ray's Supreme
Roehr's Minor
Roumanica
Ruffles
Russell Gold
Ruth
Sagittaefolia
Scutifolia
Seaby Hall
Shamrock
Snowflake
Spear Point
Star
Sweetheart
Sylvanian
Teardrop
Telecurl
Thorndike Sub-zero
Tiny Leaf
Tomboy
Transit Road
Triton
Walthamensis
Weber's Californian
Zwiekers

Fig. 9. Detail of exhibit.

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Gymnocladus in flower

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THE MORRIS ARBORETUM

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Cover Illustration---*Gymnocladus* in Flower

The cover illustration shows an inflorescence of *Gymnocladus dioicus*, Kentucky coffee-tree, native to eastern United States. The species is generally dioecious, and this picture shows a spray of male flowers from a very large male tree on the Arboretum grounds. The flower clusters are borne at the tip of the branches.

Gymnocladus, unlike the majority of the Pea family, has regular instead of papilionaceous flowers. There are a tubular 5-lobed calyx, five greenish petals and ten stamens enclosing a short style. The fruit, however, is a legume like the rest of the family. It is a brownish, broadly oblong, flat and thick pod with several large flattened seeds.

Gymnocladus, *Gleditsia* and *Cercis* are the only native woody genera of the subfamily Caesalpinioideae in the Pea family. The other genera are all of tropical distribution. Another point of interest is that it is one of those genera that occur disjunctly in eastern North America and eastern Asia. There are only two species in the genus; the other grows only in central China. *Gleditsia* and *Cercis* are similar in their distribution, except that their ranges are wider, there are more species represented and that the latter is also present in southeastern Europe and Western Asia.

Kentucky coffee-tree is a large tree and has large doubly pinnate-compound leaves. It is useful for bold painting. The tree is so named because seeds were used for coffee west of the Alleghenies before and during the Revolutionary war.

H. L. Li

The Cultivation of Trees by Mankind

Hui-Lin Li

From the very beginning of the human race, man and trees were intimately associated. Trees, as civilization gradually progressed, became increasingly important to mankind by providing such basic needs as shelter, clothing, and food, as well as drugs, poisons and dyes. Consequently trees played a not insignificant role in the religion of primitive peoples and were one of the most frequently mentioned subjects in early legends and folklore.

Man's earliest associations with trees were, of course, with those of the native forests. At a very early date, however, some trees were deliberately planted, long before any written languages began to appear to record such an event. Most probably, the earliest planting of trees happened at many different times and places independent of each other.

Beginning of Agriculture

As the ice sheets of the last Glacial Age began to recede, some 50,000 years ago, man, the primeval savage, entered slowly into what is now called the Palaeolithic Age. He was then a hunter of foods and he was both carnivorous and herbivorous. Besides whatever animals he could capture with his crude stone implements, all kinds of nuts, berries, fruits, herbs and succulent rootstocks were among his diet. Plants probably furnished more of his foodstuff than animals, and he had apparently acquired some knowledge about plants from his remote arboreal ancestors.

It is generally believed that the present races of mankind appeared some 15,000 years ago, and this marks the dawn of civilization. This is known as the Neolithic Age, as man was able to make more polished stone implements, to produce pottery, and to begin domesticating animals and cultivating plants. He was able also to utilize plant materials for plaiting and weaving.

All these changes that took place were, of course, very gradual and there is no sharp break between one phase of culture and the other. Just how and where man first acquired the knowledge of cultivating plants and utilizing seeds is a story lost in remote antiquity that can never be clearly revealed to us.

We know, however, the Neolithic man in Europe cultivated wheat, barley and millet. He used crude implements made of wood for cultivation. He also ate peas and crab-apples and perhaps also cultivated these in their wild forms.

Beginning of Tree Cultivation

The cultivation of certain fruit trees might have begun as early as the cultivation of cereals or might even antedate the latter. This is, however, purely a hypothetical suggestion. Primeval man apparently used wild nuts, acorns and fruits before grain cereals. However, the knowledge of growing plants from seed would be more readily acquired from annual herbs than from trees with a much longer life span.

Although it might be difficult for the primitive man to comprehend the relationship between planting seed with the kind of mature tree eventually grown from it, it should be noted that some trees grow easily from cuttings, a process that can be readily detected. The use of stakes for making protective hedges and of timbers for building shelters and the accidental rooting of some of the materials would soon reveal to the early man the secret of growing and propagating certain trees. Moreover, the early development of weaving and plaiting with such materials as willow twigs which grow readily from cuttings would similarly contribute to such an advancement in human knowledge.

Whatever scattered knowledge on growing plants developed among the primitive peoples could be brought to others by migrations, warfare and other intermixtures. It is the diffusion and accumulation of knowledge that brought about continuous advancement in civilization.

Between some ten to twenty thousand years ago, as the primitive man developed agriculture and gradually settled down to food-producing instead of food-hunting, a great change occurred in the living conditions of mankind. Settlement began in small communities which made possible more rapid development of various phases of human civilization. With these settlements, trees were planted to afford shade and protection, to provide edible fruits and nuts, and to furnish symbols for worship and as memorials. Naturally grown trees of great size or age or of high yield in fruit were probably first singled out for preservation, but later trees were deliberately planted for these purposes.

The Tree of Life

Trees were frequently mentioned in the Bible. The second chapter of Genesis says, "And out of the ground made the Lord God to grow every tree that is pleasant to the sight, and good for food; the tree of life also in the midst of the garden, and the tree of knowledge of good and evil."

The tree of life conferred on man immortality. The tree of knowledge gave the power of distinguishing good and evil. One was moral and the other prophetic, the sign of the first revelation to man. They belong to paradise and were intended to teach the primitive man in moral duty, and in his anticipation of the world to come. (Fig. 10).

Fig. 10. Many versions of the "tree of knowledge" are depicted in publications of all ages. This one is from the herbal *Ortus sanitatis,* 1491.

We are now obliged to connect the early chapters of Genesis with the old beliefs of Babylonia. In another ancient civilization farther east, in China, the tree of life can also be traced in their ancient traditions. In the writings of the philosopher Li-tze, who lived about 450 B.C., there is mention of the Fairy Islands in the eastern ocean, a paradise of gold and jade palaces, beauteous birds and trees whose fruits confer immortality. (Edkins 1889).

Trees for Worship and as Memorials

Trees are thus associated with the earliest religious belief of man. In ancient times among all peoples trees of massive size and great age became mystical symbols and subjects of worship. In the mythology of all races, trees are very frequently mentioned. Even to this day old trees are often still worshipped or revered among peoples of more primitive culture or more superstitious beliefs.

In the Scriptures trees are mentioned not only for use as ornamentals but were also planted, as is still the case in cemeteries, as memorials. Later on in Roman days, Pliny observes, "In old times trees were the very temple of the gods; and, according to that ancient manner, the plain and simple peasants of the country, savouring still of antiquity, do at this day consecrate to one god or other the godliest and fairest trees that they can meete withall; and verily, we ourselves adore, not with more reverence and devotion, the stately images of gods within our temples, the very groves and tufts of trees, wherein we worship the same gods in religious silence." (Holland's translation of Pliny's "Natural History", p. 357).

Pliny goes on to say, "The ancient ceremony of dedicating this and that kind of trees to several gods, as proper and peculiar to them, was always observed, and continuous to this day. For the mighty oak, named esculus, is consecrated to Jupiter, the laurel to Apollo, the olive to Minerva, the myrtle to Venus, and the poplar to Hercules."

In the Far East the use of trees as memorials also began very early. In the Chou dynasty (1122-240. B.C.) long traditions had already established the five official memorial trees for the tombs: pine for kings, arbor-vitae for princes, Sophora (pagoda tree) for higher officials, Koelreuteria (China-tree) for scholars, and poplars for the common people. (Figs. 11-14).

Fruit and Nut Trees

The origin of cultivation of many of our common fruit trees is lost in antiquity. Their domestication began in prehistoric times and

Fig. 11. An ancient Juniper planted in Central Park, former imperial garden, Peking, China. (From *Journ. Arnold Arb.*, 1926).

thus it is now impossible to trace back to their ancestral forms. In some cases the wild ancestral species are probably still extant, but they bear only remote resemblance to the cultivated types which have changed greatly under long cultivation. In most others the original wild types are long extinct. There may be occasional claims of discoveries of the wild types of certain of our long domesticated fruit trees, but these are often only naturalized escapes of cultivated plants and not spontaneous wild forms.

The absence of wild prototypes of some of our common fruit trees, like many of the cereals, attests to their great antiquity. Such fruits as apples, plums, pears, peach and cherries are among the earliest cultivated plants of man. These fruit trees originated in two major centers corresponding to the two great centers of civilization of the Northern Hemisphere: Eurasian, that is Western Asia and Europe, and eastern Asia. Among the different apples, pears, plums and cherries, there are Eurasian groups as well as Chinese groups of each kind. There are also grape, fig, date-palm and others of Western Asiatic origin and peach, oranges and others of eastern Asiatic origin only.

Some general ideas about the process of early cultivation and domestication of these fruit trees, long lost in antiquity, can be gained by observing the development of fruits in the New World in recent history. In temperate North America, there are many wild species of *Prunus* and *Vaccinium* and other genera that bear edible fruits. The introduction of these trees into cultivation began only in the last one to two hundred years. Out of the very many species, a few have proved to be promising fruit trees, such as plums, blueberries and cranberries, but others such as native apples, cherries and other berries have found to be of little or no value. Thus, although many species are available and tried out at first, most fall into disfavor in one way or the other. Gradual elimination will eventually leave only a few of the most worthy ones. These by intense selection and improvement, will ultimately become so different from their wild prototypes that their relationships may be difficult to recognize by the future generations. The general course of development of fruit trees in the Old World in prehistoric time is undoubtedly similar.

Acorns and nuts must have been used by man since the remotest times. The remains of the Pekin man, living some 100 thousand years ago in northern China, show that hackberries were already used as food. The improvement of nut trees under cultivation, however, has not been carried out as far as the edible fleshy fruit ones.

Fig. 12. Old trees of Arbor-vitae in Central Park, Peking, China. (From *Journ. Arnold Arb.*, 1930).

The most valuable and widely used nut of the whole world is the cocoa-nut, a maritime palm of the tropics. There are many other nut trees in the tropical and subtropical regions of the world. The most important nut of the temperate world is the walnut, *Juglans regia,* a native of Central Asia to southeastern Europe. Other important nut trees of the North Temperate Zone are chestnuts, hazel-nuts and almond. (Fig. 15).

For further details on the origins of the various fruit and nut trees, the interested reader can consult such authoritative treatments by DeCandolle (1884) and Vavilov (1926, 1951).

Trees for Shade and Ornament

In nearly all cases the ancestral forms of cultivated shade and ornamental trees are still known. This shows that the planting of trees for shade and ornament began later than fruit trees. These trees, as compared with fruit trees, are less variable, indicating also their relatively shorter history. Furthermore, the parentage of most of the hybrid trees originated in cultivation can still be clearly traced.

In the Scriptures, trees planted for ornament are frequently mentioned. Solomon, for instance, transplanted cedar to the plains from

Fig. 13. Cryptomerias on temple grounds, Nikko, Japan. (From Elwes & Henry, *Trees Gt. Brit. & Irel.*, 1906).

Fig. 14. A huge Yew tree in a church yard, Tisbury, England. (From Elwes & Henry, *Trees Gt. Britain. & Irel.*, 1906).

the mountains. The cedar is, in the book of Ezekiel, to be frequent in magnificent gardens.

Reliable information on trees known to the ancients, down to the time of the Greeks, is to be found in the works of Theophrastus. Many of the plants mentioned by him were identified by Sprengel (1808). Sprengel's identifications were subsequently revised and amended by Stackhouse in his edition of Theophrastus' *Historia Plantarum.* A list of not less than 170 ligneous plants selected out of this work is given by Loudon (1838). These include many trees and shrubs native to Greece and also others such as peach, persimmon and cherry which were introduced from other countries. While most of the plants are economic ones, a number of the trees valued mainly for shade or ornament, such as elm, plane, beech and alder are also listed. (Figs. 16-17).

The writings of the Romans contain the knowledge of all the trees possessed by the Greeks but to this are added also the trees of the colder regions of Europe. Among ornamental trees, the pine, the bay, and the box appear to have been favorite trees of gardens. Many other trees were planted for various useful purposes such as for their wood and fruit, or as fuel and other usages. The most reliable source of information on trees of the Romans may be found in Pliny's "Natural History." The species mentioned in there were also identified by Sprengel.

In ancient China, the highways of the Chou dynasty (1122-240 B.C.) were famed for their smoothness. These highways were known to be lined with trees. During the short-lived Ch'in dynasty (221-206 B.C.), China was unified for the first time as a single empire. The Emperor, Shih-Huang-Ti, had military superhighways built from the capital for thousands of miles in all directions to the border. These highways are

said to be fifty feet wide and were built by removing hills and filling seas to make them straight. They were all lined with pine trees. Besides pines, the trees most frequently used for street and avenue planting in ancient China were willows, Sophora, chestnut and elm.

Selection and Improvement

In cultivating plants, man has from the very beginning striven to improve on their products. In edible fruits, efforts are made to improve upon their size and flavor. In flowers, improvements are aimed at their size, color and shape. In ornamental and shade trees, it is aimed at better shape and healthier growth. In the interim of this continuous process of improvement through the centuries, new varieties appeared under various species and were preserved and propagated. The cultivated plants are one of our most cherished heritages from the past, the result of unceasing toils of endless generations of farmers and gardeners through the entire history of mankind.

Man has for centuries taken advantage of certain natural laws, without actually being conscious of, in furthering his efforts in improving his cultivated plants. Nature creates variations in plants by inserting new genetic factors (genes) into the inheritance mechanism, by causing new and abrupt changes (mutations) in these genetic factors, by altering the original setup of this mechanism (chromosomal changes), and by crossing different genetic stocks (hybridization).

Aside from effects of environment which are not heritable, these genetic changes result in creating differences among plants. No two individuals in nature are exactly alike. The differences vary from very slight and subtle ones to something quite drastic. This is called variation in genetics, the science of the study of heredity. Variation is the basis of natural selection which brings out the very complex phenomenon called organic evolution. Taking advantage of this same basic fact, variation, the keen farmer or gardener selects the one plant out of a thousand that possesses certain desirable features and plants and propagates it. This is called artificial selection or plant breeding which has been carried on through generation after generation and has produced the cultivated plants we have today.

Thus before modern genetics became a science toward the end of the nineteenth century, improvement on trees had already been done to a certain extent. In most of our common tree species there are a number of varieties and these have been mostly developed in cultivation. Many new hybrids have also been raised and maintained, especially among genera with species distributed naturally in disjunct areas and brought together in cultivation in modern times. Such geographically isolated and genetically related species often readily produce hybrids such as in *Aesculus*, the horsechestnuts and *Tilia*, the lindens. Hybrids, if fertile and bred among themselves or with their parent species, will not produce constant progenies but will show all intermediate characters ranging from one parent to the other. In other words, hybrids will not breed true to type. In tree cultivation, however, the advantage of vegetative propagation can overcome this difficulty. The progenies of a single individual, including those of hybrids, thus propagated, are all uniform in their characters, producing a line technically called a clone, and thus all desired characters of that individual can be perpetuated and multiplied.

Fig. 15. Walnut in Barrington Park, England. (From Elwes & Henry, *Trees Gt. Brit. & Irel.*, 1906).

In some such hybrids, when effected by certain internal changes, the entire complement of the inheritance mechanism (chromosomes) may become doubled. In this way the plant will subsequently be able to breed true from seed, in fact giving rise to what sometimes is called a "new species". Among the trees an example is *Aesculus* × *carnea*, the red horsechestnut, a hybrid between the common horsechestnut, *A. Hippocastanum* of Europe and the red buckeye, *A. Pavia* of North America. Both parents have a chromosome number of forty, but the hybrid has the number of eighty.

The chromosome number in a given species is normally constant. All cells of the plant carry the same number of chromosomes with the exception of the gametophytes and gametes, the gamete-producing generations and the reproductive cells respectively, in which the number is reduced to one-half. The male and female gametes eventually unite to produce the new embryo and seedling. With regard to chromosomes the number in the embryo and consequently in the mature plant is known as diploid, meaning two sets, and the number in gametes as haploid. When the gametes unite to produce the new embryo, the haploid number is restored to diploid, thus completing the cycle.

Fig. 16. A Yew avenue at Midhurst, England. (From Elwes & Henry, *Trees Gt. Brit. & Irel.*, 1906).

Changes in chromosome number occur frequently in nature for various undetectable reasons. The change may involve the addition of one or a few more chromosomes (aneuploidy). It may be multiplications of entire sets of chromosomes (polyploidy) such as the addition of one, two, three, etc., sets to the original two (triploid, tetraploid, pentaploid, etc.). It is now found that such a change in chromosome number can sometimes be induced by artificial means such as treating with colchicine.

All such changes in chromosome numbers, like all other changes in the basic genetic pattern (genotype), bring corresponding changes in the appearance of the individuals (phenotype). Whenever new and desirable characters of heritable nature appear, characters due to genetical and not environmental effects, the keen plant breeder will have a chance to select and perpetuate.

Professor Zirkle (1935) has traced very lucidly the history of plant hybridization in former times in his book *The Beginnings of Plant Hybridization.* He thinks artificial pollination was invented very early, probably antedating the invention of writing, as authentic records of pollination extend back to Babylonian times. Many fruits, such as the date-palm and the fig, were hybridized by the ancients in prehistoric times, though only incidentally. But in ancient and medieval times, the sexes of plants were not clearly known and gardeners and agriculturists on the whole were ignorant of the function of pollen. Thus spontaneous hybridization was not early recognized, and was explained as spontaneous degeneration. Accurate accounts of plant hybridization date from the first half of the eighteenth century, but it was apparently practiced earlier. Most of the hybrid trees are developed, recognized and selected since that time.

Dispersion of Cultivated Trees

Plants were known to be deliberately transplanted by men since the earliest historical times. Abraham brought trees from other lands for planting. Solomon collected all kinds of plants and he not only had an orchard of fruit trees but also planted on his ground what were called barren trees; among these the cedar was apparently brought from the mountains.

The earliest historic record of foreign plant introduction is in the fifth Egyptian dynasty, dated by modern historians as around 1570 B.C., when Queen Hatshepsut brought foreign seeds and plants from the land of Punt — generally believed to be the east coast of Africa. She sent her ship to this foreign land for seeds and trees so she might produce the aromatic incense in her own gardens. She caused sculptors to accompany the expedition, and, returned, they carved and set up a bas-relief at Luxor showing gardeners loading the boat with incense trees in tubs and piling its decks with seeds.

One of the seven wonders of the ancient world is the Hanging Garden of Babylon of the third century B.C. It was planted with exotic flowers, trees and lianas. Pumps worked day and night to water this celestial garden, which towered 430 feet into the air. The garden was built by the King of Assyria as a pleasure seat for his queen Shammuramat, whom the Greeks called Semiramis.

In China, records state that at the death of Confucius in 481 B.C., his disciples, reputed to be 3,000 in number, planted trees in his graveyard as memorials, all brought from their native regions far and wide. This may be called the first arboretum on record, a garden of trees and not just a park or orchard. In ancient China, records of tree introduction from foreign lands by various emperors are quite numerous. Many monarchs built extensive gardens and had trees transplanted from distant lands. In the second century B.C., Emperor Wu-ti of the Han dynasty, for instance, had Litchi transplanted, though unsuccessfully, from the newly conquered Annam to the capital in northwestern China.

The story of plant dispersion and introduction has been carried on through all ages and in all countries. Plant introduction has been carried on so naturally and so gradually that few people, even historians, realize the importance of its role played in the advancement of human culture. The processions of restless and wandering men have for centuries carried with them seeds and plants, favorite vegetables or fruits or trees that harbor a longing of nativity. Plants have been transplanted from point to point on the earth for food, beauty or mere sentiment.

Relatively few records of plant introduction, however, are recorded in historical chronicles. Numerous instances of introductions, deliberate or accidental, made by merchants, travellers, pilgrims and adventurers, or brought about by migrations and invasions, never entered into any writing. Our study on plant dispersion has to be made largely by inferences based on circumstantial evidence.

In plant dispersion, the most important route in ancient times was the trade route known as the Silk Road connecting the two great centers of civilization in the East and the West through the deserts of Central Asia. Peach, orange and some other fruits were carried from China to Persia in very early times. Grape, pomegranate and others were brought from there to China around the second century B.C. The weeping willow reached Babylonia from China through the same route at an unknown date. After the tenth century, contacts between the East and the West, in addition to this overland route, were also effected by merchant ships sailing across the Indian Ocean.

The discovery of the New World initiated an age of great plant migration. The beginning of this important chapter of human history, however, came with no fanfare. Scarcely two weeks after the arrival of the first settlers on the Island of Jamestown in 1607, the pioneers had carved new habitations out of a virgin land, and were planting seeds of vegetables and trees brought over from the Old World. On the other side of the continent the early Franciscan fathers planted fig, grape and olive in California where they still persist today.

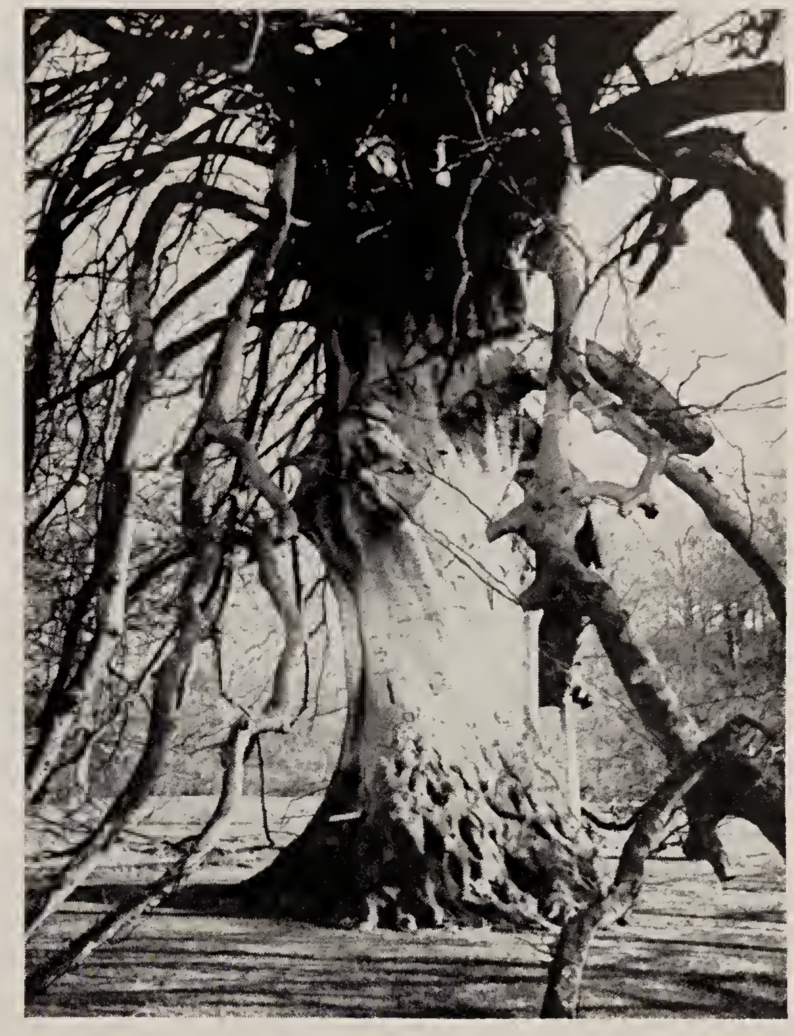

Fig. 17. An old Beech tree at Newbattle, England. (From Elwes & Henry, *Trees Gt. Brit. & Irel.*, 1906).

Not only Old World species were brought to new grounds for planting, but numerous new species from the hitherto unknown flora of North and Central America were also being introduced into cultivation for the first time. In a brief span of three hundred years, American trees are planted all over the world, and the Black Locust is to become the most widely planted tree of mankind.

Modern Botanical Explorations

The great maritime activities from the sixteenth century onward not only resulted in the discovery of so many lands in the New World but also in the opening up of vast areas in the Old World formerly forbidden to the outside world. Sailors and adventurers were soon followed by botanical explorers in quest of new plant resources. Their interests were at first largely centered around economic plants and plant products, but later the interest was extended to ornamentals and subjects of pure botanical significance.

The New World of course, revealed an entirely different flora and vegetation, both as to cultivated as well as spontaneous plants. It is not necessary to emphasize here the great impact on the Old World economy made by such crop plants from the Americas as maize, potato, tobacco and many others. Numerous trees from America were also introduced and planted, and altered much the scenery of many Old World cities and gardens. Suffice to say that to this day exploration in the New World is still being actively carried on as vast areas in Central and South America remain little known botanically.

Botanical exploration in the Old World in the nineteenth and twentieth century has also revealed, among other things, the extremely rich flora of temperate eastern Asia in China and Japan. Not only that cultivated plants of economic or ornamental significance are numerous there, but the more remote mountainous districts are found to contain flora that is richer than any other part of the temperate world. Many of the species have since been introduced into cultivation, trees, flowering shrubs and herbs that have contributed greatly toward tree-culture and horticulture of the entire world.

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Arboretum Activities

The Staff

The Director has been invited by Dr. Detlev W. Bronk, President of the National Academy of Science and the American Research Council, to serve on the newly formed Advisory Committee of the Office of Documentation. The purpose of this committee is to study the world-wide problems of scientific documentation.

On Sunday, May 15, the Director lectured before the Philadelphia Chapter of the Cactus Society which holds its monthly meetings at the Arboretum. The subject of his talk was "A Botanist in Mexico." On May 22 he was the principal speaker at the annual meeting for the Friends of the Tyler Arboretum at Lima, Pennsylvania. His topic was "The Nature and Functions of an Arboretum."

Dr. H. L. Li gave the course on the Taxonomy of Angiosperms in the Department of Botany.

Dr. Patricia Allison presented a series of lectures on Fungi in the course on Comparative Morphology of the Lower Plants and also lectured in the course on Mycology.

Holly Society Meeting

From April 20 to 22 the American Holly Society held its annual meeting in Philadelphia. On Saturday, April 22, the members in attendance spent the morning at the Morris Arboretum inspecting our collection of hollies.

Each visitor was given a mimeographed list of the 115 species and varieties of *Ilex* included in our main holly planting on the slope below the Gates Building. This grouping contains 22 species and a large number of hybrids, varieties and cultivars. For example, in *I. opaca* alone there are 58 named forms and in *I. Aquifolium* there are 26. Members of the staff were on hand to aid the visitors in locating the various forms which they wished to study.

Plant Distribution

The annual distribution of plants to our Associates was held on May 20 and 21 and proved to be a highly successful event. More than 250 of our Associates visited the Arboretum in person to claim the two plants allotted to them. The list of available items included many rare and unusual species and varieties.

Gift of Books

The Library of the Arboretum has recently received a small but choice collection of books on botany and horticulture from the estate of the late Morris L. Cooke.

This valued gift was made possible through the generosity of Mr. Cooke's niece, Mrs. Charles O'Connor of Chestnut Hill.

J. M. F., Jr.

Gibberellin: A Growth-Promoting Substance

Edith C. Gall

History

We have been hearing much about gibberellins these last few years. However, the effects of gibberellin were noticed as early as the late 19th century. Since the work had been performed by Japanese scientists and reported in their journals, their observations had been overlooked by western scientsts.

Rice is a very important crop in the Orient. Any disease that affects this crop is important to many people. In 1898 S. Hari (4) a Japanese pathologist in Formosa, studying the diseases of rice, found that an ascomycetous fungus, (*Gibberella fujikuroi* (Saw.) Wollenw.) produced elongation in rice plants. This was given the descriptive name of bakanae disease. The Japanese meaning for bakanae is "foolish."

The manner in which the disease affects the rice plants is very striking. Infected plants become considerably larger than disease-free plants. In the infected plants roots are produced about a foot above the water. From the nodes where these adventitious roots have appeared a cottony fungus forms which later becomes pink. Slightly diseased plants can survive to heading, but they produce fewer spikelets and a smaller panicle; severely diseased plants either die before heading or, if they survive, the panicles they produce are sterile.

E. Kurosawa, in 1928 (4) reported that rice developed symptoms of the disease after treatment with filtrates from cultures of the pathogen, and in 1935 (5) reported that he had isolated an active crystalline material.

It was not until after the war that this Japanese work became known to western scientists and since 1951 considerable research has been carried on. Much credit is given to Frank H. Stodola, of the United States Department of Agriculture, who compiled the first lengthy collection of abstracts on this work (4).

Through the renewed efforts of British, American and Japanese scientists, it was discovered that the active crystalline material isolated first by the Japanese was not a pure product but actually contained four active substances, one of which is now known as gibberellic acid. All these compounds are closely related, being tetracyclic dihydroxy compounds, but cause slightly different reactions. It has been mentioned that the complex lactone ring is essential for biological activity.

Effects of Gibberellin

The effects of gibberellin on plants have been noted from various sources. The most prominent effect has been the increased vegetative growth. This kind of growth shows itself in many ways. The stem may become longer, leaves may develop a different size or shape, the root growth may be altered, and there frequently are changes in the fresh weight or dry weight.

Stem Elongation. Ascertaining how this unusual stem elongation takes place has been a subject of research. Does it occur because of increased cell division or because of cell elongation? It has been generally conceded that with annual plants especially, it is a matter of cell elongation. Work done by S. H. Wittwer on woody ornamentals has proved also that cell division occurs (3). When *Ligustrum obtusifolium Vicari* was subjected to concentrations of 10, 100 or 1000 parts per million of gibberellin applied in a single foliar application in early May, there was a marked increase in terminal growth with increasing concentration (Figure 18). However, when sprays of 100 ppm of gibberellin were applied weekly during the growth period, there was far greater growth than with the other treatments. Furthermore, it was found that the internode length increased and was maximum for 100 ppm applied weekly and that the number of nodes on plants that grew the most was greater than in the untreated controls. This could come about only if there were cell division. Even though there were these greater increases in growth of stem, the gibberellin treatments also produced various injurious side effects.

Further evidence that cell elongation takes place was shown in the work of Kato in 1955 with *Lilium longifolium* (4). Gibberellin markedly stimulated pollen germination. Since the pollen tube involves a single cell, this, then could only take place by elongation.

There is also additional evidence that increased cell division can take place as well as cell elongation. Sachs and Lang in 1957 learned from microscopic examination that there is an increase in the number of cell divisions in the subapical region of nonvernalized rosettes of the biennial *Hyoscyamus niger* (henbane). It was also noted that the cell length increased only four times in a shoot which lengthened over thirty times. Lang further observed that the stem internodes are

practically non-existent in the rosette plant and therefore concluded there must be additional cell division before cell elongation.

Additional Effects of Gibberellin. Gibberellin acts differently from auxin on decapitated sunflower and tomato seedlings. With auxin callus is formed showing cell division, but with gibberellin no callus is formed.

The leaves of treated rice plants were shown to be longer and narrower than in normal rice. It has also been noted that the leaves become yellow because of a lack of root growth to support the increased top. However, this deficiency can be overcome by increasing the use of fertilizer during this period. It has been shown that there is reduction in length, weight and number of roots.

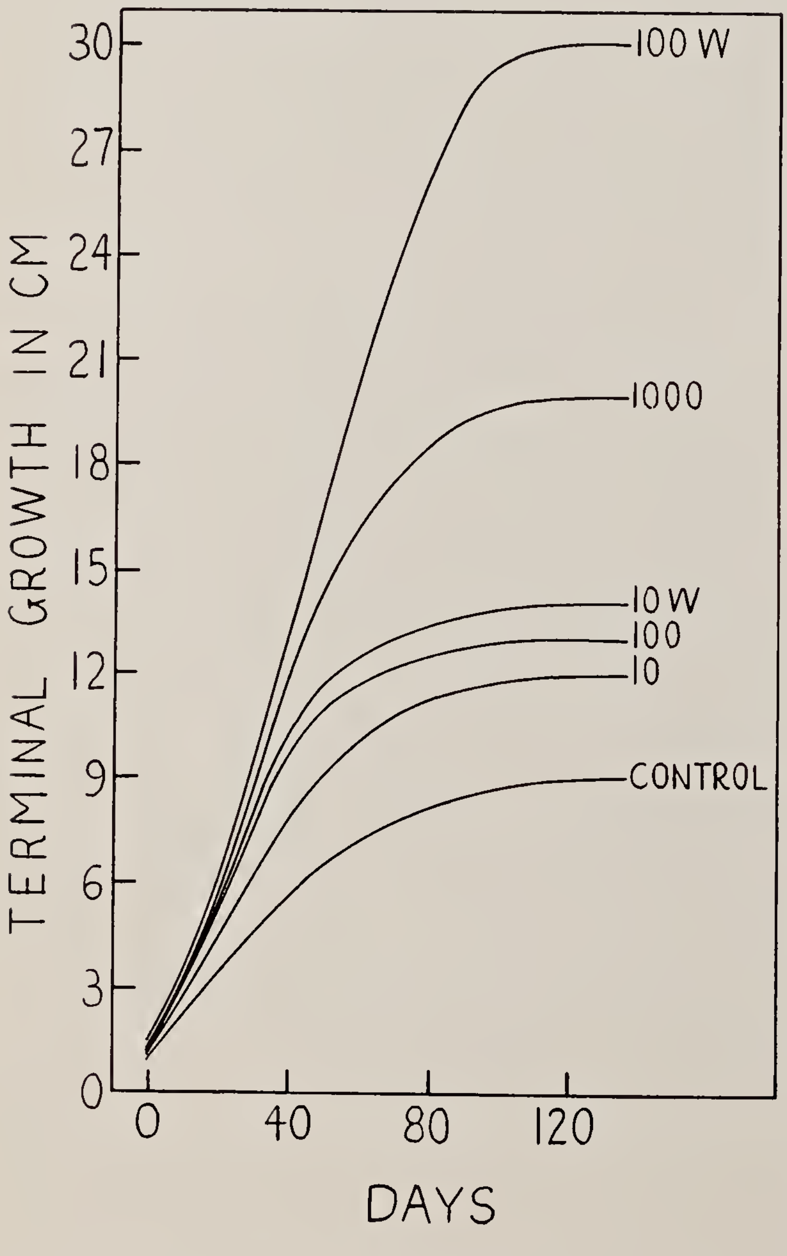

Figure 18. (Data of McVey and Wittwer) Growth in length of terminal shoots of *Ligustrum obtusifolium Vicari* sprayed with gibberellin. Numbers indicate the concentration in ppm. 10W and 100W signify weekly applications.

Growth responses of celery twenty-five days after sprays of varying concentrations of gibberellin were reported by Wittwer and Bukovac (6). (Table 1).

Table 1

(Wittwer and Bukovac) Growth Respo. se; of Celery 25 Days after Spraying with Gibberellins

Concentration ppm	Petiole Length cm	Plant Height cm	Fresh Weight gm	Dry Weight gm
0	13.2	27.2	13.2	1.01
10	17.2	33.5	18.5	1.38
100	19.8	36.8	19.2	1.41
500	19.7	38.2	20.5	1.54
1000	20.8	36.5	16.0	1.13

The significant increases shown here are in both fresh weight and dry weight. They have increased up to 50 per cent. Two to three weeks after spraying another variety the leaf petiole increased in thickness and the length was doubled.

It has been suggested that the increased rates of growth in size and weight were the result of either increased rate of photosynthesis or more efficient utilization of photosynthetic products. Haber and Tolbert (2) studied the photosynthesis in gibberellin-treated oat leaves, utilizing radioactive carbon dioxide. The rate of $C^{14}O_2$ fixation by leaves two hours after beginning gibberellic acid treatment ranging from 1 to 1000 ppm was not significantly greater than that of the untreated leaves.

Other effects of gibberellin have also been noted. One of the more spectacular was the observation of Brian and Hemming in 1955 that dwarf plants were converted into tall plants (4). Phinney in 1956 (5) reported a similar result with dwarf mutants of corn, and Wittwer and Bukovac had similar results with dwarf peas (7).

Gibberellin has a marked influence on fruit production. Grapes when treated gave a higher yield and better quality. Tomatoes were made to give a better yield by the production of fruit without seeds. Gibberellins were sprayed on the flower clusters or were applied directly to the ovary through the use of a lanolin paste or a water solution. Concentrations up to 1000 ppm were used in testing the effectiveness in setting tomato fruit without pollination. Applications of 100 ppm were most effective in all three types of treatment.

Gibberellin has been used in seed treatment to hasten germination. This lessens the possibility of damping-off, root rot, and weed competition. When soil is treated, more uniform germination of weeds results; therefore a larger percentage of the potential weed population is available at one time for eradication.

Another application of gibberellin not usually considered but still of possible usefulness is the shaping of trees. Relatively high concentrations are used and die-back of shoots occurs. With this same idea in mind, gibberellin has been used in the chemical thinning of peaches, plums and apples.

The production of "juvenile" leaves, as found in the ivies, has occurred after the application of gibberellin.

Breaking of Dormancy

In 1956 (4) Anton Lang noted that gibberellin applied to *Hyoscyamus niger*, a biennial, caused stem elongation and flowering in one year.

That is, the need for cold treatment was eliminated but not the long-day requirement. However, Lona, in the same year, but working with a different biennial, was able to replace the long-day requirement with the use of gibberellic acid under short day conditions. Consequently, it is possible to have certain biennials flowering in one year.

Gibberellin has been used to great advantage in aiding the sprouting of tubers before the customary rest period. Also, certain dormant tree buds can be forced into growth. Thus, if such plants can be forced to grow earlier than would be normal the range in which they can be grown can be increased. This material can be used for speeding propagation. Cuttings taken during or immediately after rapid elongation has occurred will root more quickly than cuttings from "non-juvenile" shoots.

As well as breaking dormancy, gibberellin can also postpone dormancy. If applied just before differentiation of the infloresence, that is, just before flower formation begins, the plant continues to grow vegetatively and does not become dormant at its usual time. This method has been applied in the growing of *Hydrangea* and other ornamentals, such as *Forsythia* 'Arnold Dwarf' and *Phellodendron amurense*.

In general, deciduous trees are more responsive to gibberellin than are conifers; also trees that grow continuously are more sensitive to gibberellin than those that grow by flushes. Maples and tulip trees are very sensitive to treatment.

Is gibberellin formed only by fungi? There is some evidence that there are similar substances produced in green plants. Phinney and West, as reported by Wittwer and Bukovac (7), made ethyl ether extractions of young bean seed and obtained an active substance that evoked a growth response in certain dwarf mutants of maize. This response is indistinguishable from that obtained with two of the chemicals of the gibberellin group.

Possible Uses and Dangers

Some favorable or potential uses for gibberellins on woody ornamentals include: an increase in terminal growth with no loss of aesthetic value (the possibility of two years' growth in one); the same as previously mentioned but with a loss in aesthetic value (to be used by the nurseryman in propagation by the induction of "juvenile" cutting wood on hard-to-root plants); the combination of a gibberellin spray program with pruning for promoting shoot growth from axillary buds so that a dense, compact plant develops in a shorter time; the elimination of pruning in some plants by the killing of terminal meristems; the promotion of growth in dwarf varieties; the abscission or desiccation of flowers on plants which produce obnoxious fruit; and the increase of flower size in some species.

There are some injurious effects that must be noted. Increased growth leads to a spindly appearance and a weak plant. Frequently there is leaf distortion. Also there is more top than the roots can support and chlorosis develops. This can be overcome in some instances by the addition of fertilizer along with the gibberellin treatment. It must also be remembered that gibberellins do not initiate root development.

Methods of Application

A stock solution is prepared by dissolving 1 gram of gibberellic acid in a minimum amount of 95 per cent ethyl alcohol containing 0.1 per cent wetting agent, such as Tween 20, and diluting with water to make one liter of solution. Potassium gibberellate is completely water soluble but a wetting agent is still needed. It is also important to consider the purity of the material. Commercial gibberellic acid has 91 per cent active material, potassium gibberellate 82 per cent. These solutions can be used in spraying.

Another method of application is the use of lanolin pastes. A one per cent paste is obtained by placing 12.5 milligrams of acid into a small vial, then dissolving the acid by warming it with seven drops of a spreader, such as Tween 20, and finally mixing it with one gram of melted lanolin.

Other methods are the use of aerosols which will deliver .05 milligrams per second or the use of fertilizer containing the gibberellin.

Most garden supply stores carry products which give complete instructions on the label as to the dilution required for the concentration desired.

The timing of the application is important to get the desired effect. Also it is frequently better to repeat a low dosage periodically rather than rely on one application of higher concentration (1).

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Book Reviews

THE EVERGREENS. By James H. Beale. Doubleday & Co., Inc., New York. 1960.

EVERGREENS FOR EVERY STATE. By Katherine M-P Cloud. Chilton Co., Philadelphia and New York. 1960.

Two useful books on evergreens appeared at nearly the same time. Both are intended for use by the general reader and home gardener.

The first book carries on the jacket the following legend: "How to select, plant, transplant, cultivate and care for all types of evergreen trees and shrubs" and the latter "How to select and grow evergreens successfully in your own locality". The purpose of both is therefore the same, except that the latter puts more emphasis on regional usages. For this it provides a hardiness zone map inside the cover and two reports on evergreen performance from the States and from Canada respectively. Both of these are very useful features.

In both books, broad-leaved evergreens as well as conifers are treated. After general treatises on planting and caring of these plants, both books devote the larger part of the text in describing and discussing the individual groups of plants. Beale's book treats these by families while Cloud's treats these alphabetically by genera. It seems that for general horticultural usage, the latter is a more suitable arrangement for the reader.

Neither of the two books follows the current accepted practice of printing cultivar names in Roman with brackets instead of as Latin trinomials. Cloud's book follows closely the nomenclature of Rehder's classical manual. Although the same manual is also mentioned in the preface to Beale's book, he uses a number of names such as *Pseudotsuga mucronata, Pinus nepalensis,* and others, which are long obsolete. It seems that the value of this book might have been improved upon with the consultation of a botanist as was done with Cloud's book.

H. L. Li

Azalea Petal Blight is in the Philadelphia Area

Patricia Allison

Spring is sometimes slow in coming to Philadelphia. Early crocus gladdens the heart, to be sure, but there is never a rush to put woolens away. Nor does the fragrance of narcissus always tempt a Philadelphian to store a snow shovel. Tantalize as it may, Spring is virtually certain when the azaleas finally begin their splurge. Suddenly Philadelphia vies with Natchez, or Charleston, or New Orleans, as the splendid spectrum of azaleas illuminates May and rhododendrons usher in June.

Even a newcomer can note, however, that one year's display may far outshine another. The azalea bloom at the Arboretum in 1958 was far superior to that of 1959, for example. Last year the colors seemed dim, the season short. This year we know why. The same fungus that in the past transformed the world-famous azalea blossoms of Charleston, South Carolina, into slimy mush in a matter of hours is now active in Philadelphia. Its name is *Ovulinia azaleae* Weiss; the disease is "flower spot" or "petal blight."

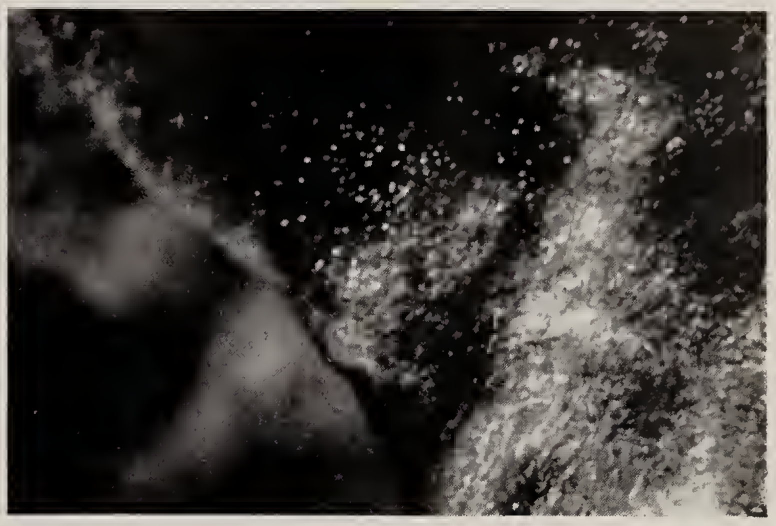

Fig. 20. Azalea petal with "sugar coating" of conidia of *Ovulinia zaleae.*

History and Distribution

The gardens of Charleston, in 1931, were the scenes of the first noted outbreak. Within seven years other plantings were affected along the Gulf Coast to Texas and up the Atlantic seaboard to North Carolina. These are areas that attract azalea lovers from all parts of the nation. By 1947 the fungus was known in Virginia, Maryland, and California. Until recently its northernmost limit was thought to be Washington, D. C. Then came news in 1956 that greenhouse crops on Long Island were diseased. Now we know that Philadelphia is within the range of the fungus for outdoor plantings, and, judging from the widespread occurrence of the disease this year, the pathogen has been here for some time.

Fig. 19. Dry azalea blossom bearing black sclerotia of *Ovulinia azaleae.*

The Pathogen

It was mentioned that the display of bloom in 1959 was less spectacular than in 1958. This was thought to be a normal seasonal variation, and the possibility of petal blight never was considered until midsummer when definite evidence of the pathogen was encountered. This consisted of tiny, black, cup-shaped fungus structures, called sclerotia, found on flowers that had not fallen from the shrubs (Fig. 19). Dr. Freeman Weiss first described and named the pathogen. He discovered that the sclerotia would remain alive over winter on the ground, and that the environmental conditions prevailing in early spring permitted the development of the next stage in the life cycle of the pathogen. This is a tiny, fleshy fruiting body, the apothecial stage, from which spores are shot into the air. Some of them land on the low-hanging flowers of early-blooming varieties; others are wafted by breezes or rain to additional blossoms. The spores germinate on the surface of the petals and the germ tubes invade the tender tissue from which food

Fig. 21. Conidia of *Ovulinia azaleae* on blighted azalea petal.

is obtained. A little later a second type of spore (conidium) is formed by the thousands on the surfaces of the petals. Under slight magnification these can be seen glistening in whitish patches (Fig. 20) or silhouetted at the edges of petals (Fig. 21). Higher magnification is needed to see that each single-celled spore has a tiny suspensor cell attached to it (Fig. 22). Other fungus structures develop at about the same time, but their exact role in the life cycle has not been discovered. Crop after crop of conidia is formed during the flowering period. These spores are carried to other flowers by wind, rain, and even insects. Only after the blossom is well rotted do the sclerotia begin to appear. At first they are whitish curved mats. Later they turn dark, and may fall out of the petal tissue to the ground.

Fig. 22. Conidia of *Ovulinia azaleae*. Note suspensor cell.

As far as is known, the fungus attacks only the blossoms. Despite this fastidious attachment for flowers, the host range among varieties of azalea and rhododendron is broad, and even *Kalmia* blooms are occasionally damaged.

Symptoms

After the microscopic spore starts the cycle, growth of the minute sporling in petal tissue results in a small spot. On white flowers, the spots are brownish (Fig. 23). On colored petals they are paler than the surrounding tissue. If weather permits, the continued growth of the fungus causes rapid destruction of the petals.

Fig. 23. Flower of *Rhododendron mucronatum* with early stages of petal blight.

The flowers sag and turn brown, plastering the leaves, transforming the shrub into an unsightly mess. (Fig. 24-25). Dr. Cynthia Westcott, who pioneered in the development of chemical control methods, describes the appearance well, saying that the bushes look as if they had boiling water poured over them. If the atmosphere remains moist, the petals are distinctly slimy. Even petals that are only half destroyed fall apart at the touch. This is an important diagnostic characteristic (Fig. 26). Another is the fact that brown areas may still retain a trace of the original small spot (Fig. 26). Still another, is the fact that dead flowers often remain on the shrub, some still attached to the flower stalk, others plastered on the foliage (Fig. 27). Symptoms on rhododendron are similar (Fig. 28-29).

Fig. 24. *Rhododendron mucronatum* and *Rhododendron poukhanense* "Yodogawa", May 11, 1960. Yodogawa bloom is half-destroyed; *R. mucronatum* bloom is spotted.

Control

The fact that *Ovulinia azaleae* causes frequent devastation in southern gardens and is now in the Philadelphia area should not lead us immediately to the conclusion that we must at once begin the same sort of extensive control program recommended for the South. There is the distinct possibility that the fungus is indeed near the northern limit of its range and that we can therefore expect serious trouble only infrequently.

Fig. 25. Same plants as in Fig. 24, May 16, 1960. All blooms destroyed.

For a time, until we know more about the particular symptomology in the Philadelphia area, it will be wise to view all supposed examples of "frost damage," "scorch," and the like with suspicion. Early season marginal browning can very well be caused by the fungus, and the stage may then be set for major collapse of bloom at peak season. Such was the case this year.

Should the experience of this spring prove to be the rule rather than the exception, azalea growers in the Philadelphia area can be both forewarned, through knowledge of symptoms, and forearmed in a very real sense with the knowledge about chemical and cultural control

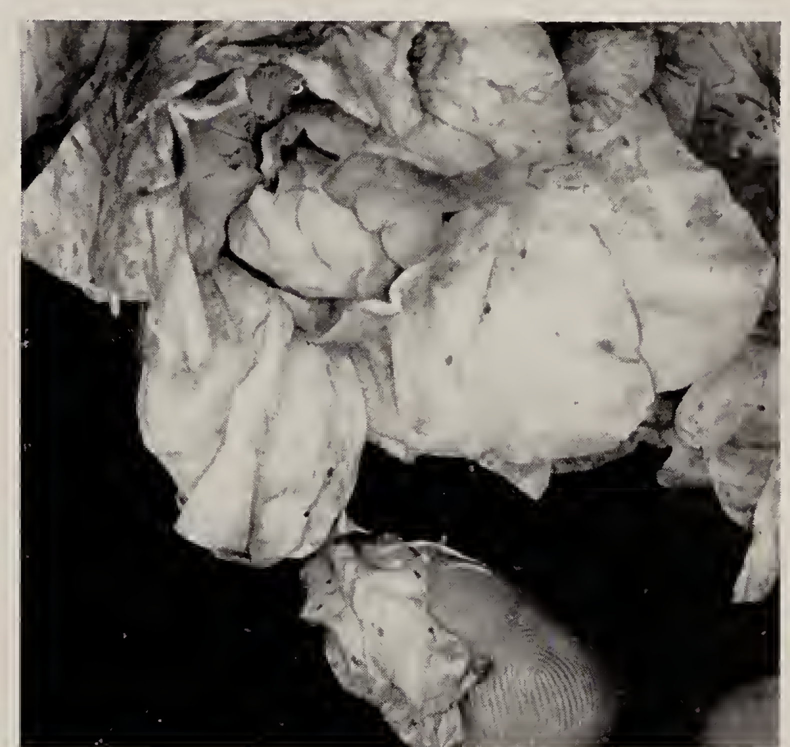

Fig. 26. The touch test for Petal Blight. Flower petal of Yodogawa falls apart at the touch. Note minute spots where original fungus invasion occurred.

methods supplied us by researchers working in the south and by industries already supplying materials for use in controlling this disease in that area.

There are now two chemical approaches to the control of petal blight. One is the application of large doses of fungicide to the ground below the shrubs when they are dormant. This, of course, is to destroy the pathogen before the spring spore ejection begins. The technique was not successful until the recent development of special compounds. Now it may very well prove to be the most important single application of the season.

The second approach has been to protect the flowers themselves throughout the bloom period. Spectacular control has been obtained with the use of zineb and Actidione-RZ. The latter material is now recommended for ground spray also. There is some indication that it may replace zineb as the treatment of choice.

Fig. 27. Azalea blooms reduced to slimy mess by the petal blight fungus.

In the south, floral spraying is begun when the early varieties are in bloom. Sprays are applied three times a week for about a month. I know of no other control technique in which the method of application is so important. Unless the spray itself is exceedingly fine, any of the chemicals that could control the fungus in near-miraculous fashion may actually damage the bloom and new foliage.

Fig. 28. Petal collapse beginning on *Rhododendron obtusum*.

The compounds must be applied as a fine mist — nearly a fog — and wafted toward the blooms from several directions.

It is hoped that such an extensive program will never be necessary in the Philadelphia region.

At present we are suggesting that Philadelphians familiarize themselves with the symptoms of petal blight as much as possible. This should definitely include examination of their own shrubs now. Flowers that are still clinging to shrubs should be inspected for sclerotia, then burned. If the fungus is found, the owner should consider using a ground spray of Actidione-RZ next year. We plan to use this treatment in some

Fig. 29. *Rhododendron obtusum* flower reduced to limp, slimy mass by *Ovulinia azaleae*.

beds where the disease was severe this spring.

Remove any dead or diseased bloom from new shrubs next year before bringing them to your garden. Petal blight of both azaleas and rhododendrons was common on plants for sale in various garden centers this year. There is little doubt that the fungus was shipped to us from the South with nursery stock. Even if your garden is not free of it, there is little sense in increasing the population still more.

Rejoice in the knowledge that the results of nearly 30 years of study and research in the South are available to you should the disease prove increasingly destructive in Philadelphia.

Associates' Corner

The Floriade

The Floriade is a great International Horticultural Exhibition now going on in Rotterdam in commemoration of the 400th anniversary of the Tulip. It opened on March 25th and will continue until September 25th. Although principally backed by the Dutch, many other nations are participating, including a large exhibit by the United States.

As the exhibition covers over a hundred acres with greenhouses, pavilions, exhibition halls and waterworks set in a fairy forest of tall trees, landscaped with drifts of flowers and ponds, it would take pages to describe in detail, so I will only touch on a few personal highlights.

The first pleasant surprise was that the posters in public places had a picture of a little child with baskets of flowers somewhat reminiscent of our own Rittenhouse Square Flower Market poster. We arrived at the height of tulip time and all over Holland the streets and houses were decorated with freshly cut flowers, even to the smallest village, and the automobiles and busses were garlanded. Roadside stands of huge garlands for sale added to the gay atmosphere.

Before entering the actual Floriade, a MUST is to go up in the Euromast at one corner of the grounds overlooking the Floriade and the fascinating activities of Rotterdam Harbor.

This is a modernistic tower 400 feet high with a restaurant on top which can accommodate 900 visitors. From here one gets a splendid view of the whole scheme of the Floriade and all the water traffic converging on the vast Harbor from the three rivers. Fortunately, this fantastic mast is to be permanent so, long after the Floriade is a happy memory, one will be able to be whisked up there in a matter of moments and spend hours fascinated by the ever changing panorama.

As a stalwart American, I headed for the United States exhibit first. It occupies quite a large area and what impressed most of the visitors was the house built of native redwood. There were, of course, many other exhibits including a magnificent garden of American grown Iris, but as the captions, when there were any, were in English, and as about only 9 percent of the millons of visitors can speak or read that language, their message failed to get very far. Practically every other exhibit was labeled trilingually.

From here we wandered through that Fairy Forest to the French contribution and then, as time and endurance were limited, we headed for several definite objectives which we had selected beforehand. Naturally they were all at the other end of the grounds. First we took a little open air trolley which deposited us at the highway which divides the area. Here we paused long enough to inspect a group of gigantic aluminum insects such as locusts, beetles, etc. which were made more dramatic by hidden sound tracks imitating their particular buzz.

Climbing into an aerial car suspended on wire we sailed pleasantly over vast flower beds of every conceivable plant, all with museum blooms. Debarking in a floral-draped station we went to the Clusius Garden. The dates on the gate to this charming enclosed garden were 1594-1609, during which time Clusius collected his medicinal herbs. I was surprised to see how many of our present day favorites had been found by him in the 16th century, including tomatoes. From here we went to the "Royal Garden" in a conservatory and which had been contributed by the Kings of Belgium, Greece and Sweden, Queen Elizabeth of England, The Grand Duchess of Luxemburg and Prince Rainier of Monaco. The Monaco exhibit was outstanding. There were masses of stag-horn ferns some 6 feet across and huge china vases at least 5 feet across filled with the most beautiful blooms of *Medinilla magnifica* I ever dreamed of. The whole display was on two levels and the arrangement had a decided Hollywood flare.

Our next objective was the "Biblical Plants and Flowers," section. The terrain was built up to represent an arid part of the world with a cloche-shaped greenhouse of bamboo where olive trees and indigenous herbs and flowers were in appropriate settings. An exceptional touch was glass doors in which Biblical flowers with their leaves and root systems were mounted. I will not go into a description of the miles of greenhouses filled with tulips, peonies and other flowers, or the enormous rose garden with roses from all over the world, but must mention the forests of Amaryllis, all over 4 feet high with blooms as large as a child's balloon.

We wandered slowly back through this dream world really saturated with beauty. At the exhibit gate was a sort of shed with a series of what looked like weighing machines, but on investigating, proved to be electric massage for tired feet. You dropped a coin in a slot and were supposedly refreshed. We did not try it.

It will interest some of our readers to know that the man who is responsible for the over-all design and landscaping of the Floriade is Mr. Meto Vroom, a graduate of the University of Pennsylvania's Division of Landscape Architecture. Mr. Vroom took a number of courses in botany at Penn and in the Summer of 1956 took the course in Woody Ornamental Plants given by Drs. Fogg and Li at the Arboretum.

Marion W. Rivinus

New Associates

The Arboretum is happy to welcome the following new Associates who have enrolled since December 1959:

Dr. and Mrs. William Baltzell
Mr. Joseph Meehan Baxter
Mrs. George Becton
Mr. Martin Brooks
Miss Mary Calwell
Mr. and Mrs. Perry Coleman
Dr. James L. Dannenberg
Mr. William M. David
Dr. Henry M. Drinker
Miss Margaret Earle
Mr. Perry Fairbank
Mr. Joseph P. Flanagan
Mr. Horace Fleisher
Mr. T. Samuel Fleming
Mrs. Eleanor R. Fogg
Mr. Ibri S. Funk
Mr. Wm. J. Germain, Jr.
Mrs. Irvin Gerson
Dr. and Mrs. Herman Gold
Mr. William M. Hanson
Mr. Frank E. Hahn, Jr.
Mr. Ronald L. Harper
Mr. R. A. Hillas
Mr. Richard N. Hood
Mrs. Peter Keating
Mrs. Richard L. Levy
Mr. Arthur D. Lichterman
Mrs. Malcolm Lloyd
Mrs. S. L. Luce
Mrs. A. Basil Lyons
Mrs. George MacLeod
Miss Julia Moore
Mrs. Wm. T. Newbold
Mrs. Henry N. Paul, Jr.
Miss Edith P. Pearson
Mrs. D. Frederick Shick, Jr.
Mrs. Joseph P. Sims, Jr.
Mr. and Mrs. Wm. Wharton Smith
Mr. Gordon S. Smyth
Mr. Jerome Stone
Mrs. Warner Victor
Dr. Adrian W. Voegelin

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Acer macrophyllum

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THE MORRIS ARBORETUM

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year
Sustaining	$10.00 a year
Supporting	$ 25.00 a year
Sponsoring	$100.00 a year
Donor	$500.00

Arboretum Activities

The Staff

On Wednesday, August 17th, the Director attended the annual meeting of the American Association of Botanical Gardens and Arboretums which was held in Boston, Mass. This session coincided with the meetings of the National Shade Tree Conference which took place at the same place from August 15th to 18th.

Dr. Patricia Allison addressed the first autumn meeting of the local chapter of the American Rhododendron Society which was held at the Arboretum on September 8th. The subject of her talk was, "Petal Blight of Azalea."

The Summer Courses

For the sixth successive year the Arboretum presented graduate-level instruction as an integral part of the Summer School of the University of Pennsylvania.

The Director, aided by members of the Staff, offered a six-weeks course on "Ornamental Woody Plants." Enrolled in this class were twenty-five students, most of whom were high school teachers of biology who were attending the University as participants in the Summer Institute of the National Science Foundation. In addition to learning to identify and recognize

(*Continued on Page 47*)

The Nature and Functions of an Arboretum

John M. Fogg, Jr.[1]

By strict definition an Arboretum is a place where trees are grown — a collection of arboreal species of plants. More broadly speaking, however, an arboretum may, and most of them do, include other ligneous plants, such as shrubs, sub-shrubs and woody vines.

One writer has characterized an arboretum as a kind of dendrological Noah's Ark. In view of the fact that with some kinds of trees, such as willows, poplars, hollies and persimmons, it is necessary to have both male and female specimens, this metaphor is not inappropriate.

The accumulation and maintenance of a representative collection of woody plants hardy in any given area involves considerable time, effort and expense. One may well inquire whether such an investment is justified and whether the benefits which may be derived from such an undertaking are commensurate with the cost.

It occurs to me that one way to obtain an answer to these questions is to ask a many-parted question in return, namely, what does an arboretum mean to the following persons or group of persons? Perhaps the replies to these queries will enable us to comprehend the true nature of an arboretum and to appreciate the multitudinous functions which it performs.

The Botanist

An arboretum is a place where the student of plant taxonomy or systematic botany can see and study a large number of authentically named trees and shrubs from many parts of the world. If the collection is arranged according to some natural system of classification he can compare closely related genera within a family or the various species belonging to a genus. If the representation of a particular genus is sufficiently large he can embark upon monographic studies leading to a better interpretation of specific relationships. If, as is often the case, the arboretum possesses an herbarium and a library, it may well become an important center for taxonomic work on world-wide groups of woody plants.

If the plants in an arboretum are arranged on the basis of habitats, rather than in systematic sequence, a fine opportunity is provided for the student of ecology to observe the effects of such factors as soil, light, temperature and water. He can plot growth rates, determine hardiness, record flowering and fruiting behavior, and observe other seasonal phenomena, such as flush — the tendency of certain species to form a second or third batch of leaves.

For the geneticist an arboretum is a place where pure lines of germ plasm may be maintained, where crosses between species and varieties may be carried out under controlled conditions, where hybridization experiments may be conducted with a view of producing better trees — better in the sense of faster growing, more resistant to disease, or more suited to a particular environment.

The plant pathologist finds in an arboretum fertile ground for studying disease symptoms and pathogenic organisms. Here are growing together plants from many different countries; here the opportunities for the introduction and transmission of new diseases are accentuated; here the need for recognition and control of pathogens is of paramount importance.

Although trees are perhaps not the most suitable subjects for study by the plant physiologist, their growth and development present many fascinating problems. Among these are matters relating to mineral nutrition, transpiration rates, conduction of sap, and pigment changes at times of autumn coloration of foliage.

The Zoologist

To the student of animals an arboretum represents a zoological microcosmos. Here, usually within a limited number of acres, may be found a variety of habitats supporting a diversified fauna: burrowing animals, small, and sometimes large, mammals, insects (including butterflies and moths), newts and salamanders, and, of course, birds.

The competition between insect and insect, the relationship between insect and plant — harmful in some cases, beneficial in others — the part played by worms in modifying the chemistry of the soil, all these and many other problems can be ideally studied in the outdoor laboratory which we call an arboretum.

The Bird Lover

No matter how small its area, any collection of trees and shrubs provides cover and a supply of food for bird-life. In an arboretum which

[1] Based upon a talk given on the occasion of the Annual Open House of the Tyler Arboretum at Lima, Pennsylvania on May 22, 1960.

covers many acres these advantages are multiplied many times over, with a corresponding increase in the diversity of species and the number of individuals. If care has been taken to include such food-sources as crab-apples, pyracanthas, and various kinds of bush honeysuckle, certain birds which normally migrate south will linger on through the winter.

If, as is the case at the Morris Arboretum, a considerable area of native woodland is available, conditions are thus provided for studying nesting and feeding habits as well as for observing spring and fall migrations. Our Bulletin has, over the years, carried several articles on the birds which have been recorded within the boundaries of the Arboretum.

The Arborist

The professional student of trees finds much to engage his attention in an arboretum. Here he may observe trees suitable for a wide variety of uses: shade trees, timber trees, pulp trees, ornamental trees, fruit trees and so on. Here he may study the relationship that exists between trees and the soil on which they grow, the exposure to which they are subjected and the amount of protection which they may require. He can learn more than he ever could from books about the height and shape of a mature specimen. Here, too, if scientific work is being conducted, he can see the results of hybridizing and grafting, of careful selection and breeding and of tests on hardiness and of resistance to disease.

Finally, the arborist, if he has an open mind, may learn that the new species of trees which are constantly being added from other climes may be superior to the ones which he has been accustomed to using or recommending.

The Conservationist

Few studies are more essential to the continuation of our way of life than those concerned with the preservation of our renewable natural resources: forests, wild-life, soil and water.

To the conservationist an arboretum, especially if it be a large one, is a place where he may learn how plants are adjusted to their environment and how to work with natural conditions rather than against them. He may learn how plants are propagated, on a small or large scale, for reforestation or other purposes. He may see something of the hygienic methods necessary for the growing to robust maturity of trees and shrubs. He may observe the pests and diseases to which they are subject and how these may be controlled. He may even, on occasion, be able to observe the effects of fire, storm, flood and erosion.

The Nurseryman

To the commercial grower of plants an arboretum has much to offer. It can help him establish the botanical identity of unknown or uncertain species. It can call his attention to newly discovered or recently introduced plants which have met the test of hardiness. It can, and frequently does, provide him either with seeds or with other propagating material of plants which he may wish to grow and distribute.

However, it should be emphasized that this relationship is by no means a one-way street. The nursery itself is frequently a source of origin for new introductions or recently developed hybrids and cultivars. Friendships between arboretums and their nurserymen neighbors are mutually beneficial and should be assiduously fostered.

Another Arboretum

A few botanical gardens and arboretums are so fortunate as to be able to send expeditions to distant places for the purpose of collecting plants to enrich their collections. Others, less favored, must frequently depend upon these larger institutions for the acquisition of novelties by gift or in exchange.

Most arboretums prepare each year a list of available seeds of trees and shrubs. These are distributed to a mailing list which includes all accredited arboretums in this country as well as many foreign ones. My own institution frequently orders as many as a hundred species from lists of seeds offered from other arboretums and botanical gardens throughout the world.

A common practice, also, is to distribute among our colleagues a list of seedlings or rooted cuttings which are ready for distribution. Many of us, when we visit a sister institution, express a desire to possess this or that particular species. We, in turn receive similar requests from those who come to inspect our collections. The pleasure of reciprocation is quite equal to that of receiving something that we have yearned for.

In these ways arboretums help to increase each other's representation of authentic material of known origin. Moreover, by exchanging their publications they aid in the dissemination of botanical and horticultural knowledge.

Industry

Many and varied are the ways in which an arboretum is called upon to render assistance to commercial organizations. The following few examples will illustrate this type of service:

A utilities company is desirous of learning what kinds of low-growing trees might be avail-

able for planting under its overhead lines in order to reduce the cost of pruning. Upon visiting the arboretum its representative discovers that there are several species which meet its requirements.

A large jewelry store wishes to utilize various native trees as a basis for designing new lines of costume jewelry. The arboretum is able to supply them with authentic specimens or illustrative material from which their artists can work.

A biochemist in a research laboratory is studying the differences in respiration rates between the pulp and seeds of various fleshy fruits. A tour of the arboretum reveals a wide range of examples from which he may select his experimental material.

A pharmaceutical concern is interested in assaying the extracts from plants containing alkaloids. The arboretum, with its large representation of native and exotic plants, is in a position to furnish it with a broad spectrum for analysis.

The Landscape Architect

For the professional landscape architect a broad knowledge of plant materials is a fundamental necessity. Plants are the basic elements of his design and the more kinds he knows and understands the richer and more varied his palette will be. In addition to becoming acquainted with a large number of trees, shrubs, vines and herbaceous plants, he should understand something of their soil, temperature and moisture requirements, their mode of growth and their size and aspect when fully grown. It is incumbent upon him, for example, to realize that a mature Sawara Cypress may achieve a height of 70 to 80 feet and not to plant one where a smaller species is desired.

There is no better place for a student of landscape architecture to learn these lessons than in a well stocked arboretum. Here he may see many hundreds of woody plants growing under ideal conditions. He may see rich collections of conifers, broad leaved evergreens, deciduous trees and ornamental shrubs and vines. He may come to realize that of 70 different honeysuckles, 60 maples, 50 barberries, 45 viburnums, 30 cotoneasters and scores of hollies, certain varieties are more suitable for given locations than others. He will soon learn that even among the species of a single genus there may be a wide diversity in growth habit, time of flowering, and color and texture of the leaves.

For several years there has been a close working relationship between the Morris Arboretum and the Department of Landscape Architecture of the University of Pennsylvania. Classes from the school visit the Arboretum every month of the year and during the six weeks of the University's Summer School they attend a course which is given at the Arboretum all day long five days a week. The major attention of this course is devoted to the identification and recognition of a selected group of about 200 species of trees and shrubs. In addition to learning the botanical characteristics of these plants, the students sketch the living specimens for the purpose of recording their form, mode of branching and type of foliage. Furthermore, they receive instruction in the principles of ecology, so that they come to understand the importance of those fundamental factors which determine the growth of plants. They are also given lectures and demonstrations in the recognition and control of plant diseases and in the techniques of plant propagation.

The end-product of this program is the turning out of a group of practicing landscape architects with a better understanding of plant materials than would be possible in the absence of such facilities.

The Teacher

For the science teacher an arboretum represents an additional educational facility—an outdoor laboratory or classroom provided at no extra cost.

Most arboretums, especially those close to metropolitan centers, are visited each year by large numbers of students from lower grade to upper high school levels. By busload or cavalcade of private cars they invade the grounds, divest themselves of some of their pent-up energy, and learn something about trees and shrubs from many parts of the world. Many of these youngsters have never before seen a tree or a lawn and years later some of them have told us what a new world their visit to the Arboretum opened to them.

For the college student of botany or biology an arboretum performs an indispensable function. Classes from the University of Pennsylvania visit the Morris Arboretum as a regular part of their course work and many other institutions of higher learning in this region avail themselves of our facilities.

Our Associates

As is the case with most of our sister institutions, the Tyler and the Morris Arboretum have a group of friends known as Members or Associates. In our own case the dues paid by these loyal supporters enable us, among other things, to publish our quarterly Bulletin and to purchase books and plants.

In return an arboretum is able to do many things for its Associates. It can hold occasions like this one today which enable its friends to become better acquainted with what is going on. It can respond to their queries concerning plant cultivation and disease problems. It can offer the facilities of its library and herbarium.

In our own case the Associates participate in the annual plant distribution, at which time rare or unusual plants are offered to those who call for them.

The Artist and Photographer

There is truly no time of year when an arboretum is lacking in interest for the painter or the camera fan. Whether it be the outline of conifers against the snow, the rich display of spring colors, the mature foliage of midsummer, or the haunting panorama of autumn hues—at every season, indeed during each month, there is something worthy of being captured and recorded by brush or film.

At the Morris Arboretum many art classes hold regularly scheduled sessions throughout the year. Near many a photogenic spot, such as the Swan Pond or Rose Garden, it is a common sight to see half a dozen easels set up while students in oil or water color work alone or under guidance of an instructor.

For nearly two decades, one of our neighbors has, on a given date each year, taken a picture of his four children in the same location on our grounds. He possesses not only an interesting record of his family's growth from early childhood to adolescence but a kind of time-lapse series of photos of this particular spot.

A collection of pictures is one of an arboretum's most valuable assets. At the Morris Arboretum we have assembled over a span of a few years a set of more than 3,000 colored transparencies. They are used in our teaching programs and for public lectures; they enable us, almost daily, to answer questions concerning the flowering and fruiting dates of a given species; and like our library books they are available to other institutions which may wish to borrow them.

The Horticultural Society

As arboretums find it possible to develop special collections of various groups of plants they are in a position to appeal to the many regional and national ogranizations which welcome an opportunity to visit their exhibits.

Within the last two years the large arboretums in the Philadelphia area have served as hosts for meetings of the American Rose Society; the American Holly Society and the local chapter of the American Rhododendron Society. The last-named organization holds its regular monthly meetings at the Morris Arboretum, with occasional meetings or field trips scheduled to the Tyler Arboretum, The Scott Foundation and other institutions in the Philadelphia area.

Few arboretums can hope to have complete collections of all genera of woody plants. There is, however, abundant opportunity for each of us to become so strong in our representation of certain groups that we may become a mecca for the enthusiastic devotees of those particular forms. In addition to the ones already mentioned, other groups which come to mind are boxwood, ivy, lilacs, tree peonies and magnolias.

The Garden Club

One of the gratifying developments of recent years has been the increasing use which Garden-Clubs have made of our botanical gardens and arboretums. Frequently this takes the form of a luncheon or dinner meeting, followed by a guided tour of the grounds or an illustrated lecture on a group of plants or some aspect of the Arboretum's activities. On other occasions the session may be devoted to a demonstration of the methods of propagating plants or a practical discourse on the recognition and control of plant diseases.

The verbal and written comments which reach us after these meetings lead us to believe that an arboretum has much to give to organizations of this kind and to entertain the hope that they will continue to avail themselves of our facilities.

The Home Owner

There is perhaps no single area in which an arboretum can make a greater contribution than in the assistance it may render to the owner of a property who is desirous of planting his grounds. This is especially true in the case of someone who has just acquired a newly constructed home on land which may be devoid of trees or shrubs. It may, however, apply equally well to the person who wishes intelligently to augment and improve an existing planting.

When one observes how many homes are surrounded only by Forsythias, Van Houtte's, Spiraea and Kurume Azaleas, it is obvious that there is a crying need for an upgrading of the level of popular taste in the selection of plant materials.

An arboretum is a place where the home owner may see a wide variety of trees, shrubs and vines, authentically named and well grown. It is a place where he may learn that, instead of a single Forsythia, a single Spiraea and a single Azalea there are numerous species and varieties, each adaptable to a given situation. It is a

place where he may see the newer forms of roses, tree peonies and magnolias growing beside the older more traditional ones. He may prefer the latter, but at least he has the opportunity of comparing them and making his own selection.

An arboretum is a place where the prospective planter can learn something of the height and form of mature tree or shrub and accordingly place it in the proper location; where he may obtain information concerning flower color, as well as the time and duration of the blooming period; where he may acquire knowledge as to which plants are truly hardy in his area and which are not, which are subject to disease and what to do about it when symptoms manifest themselves. He may also learn something of the soil requirements of certain plants and what part fertilizers and soil conditioners play in the cultivation of woody plants.

If the arboretum boasts demonstration plantings of vines, ground covers and hedges he may gain valuable information as to the most desirable forms of these special-purpose plants.

The General Public

As our cities expand and their suburbs coalesce, the quest for open space becomes increasingly difficult. As land is divided into smaller and smaller parcels the need to preserve larger and larger natural areas becomes more and more imperative.

The creation and maintenance of parks, public gardens and arboretums therefore emerge as necessities rather than luxuries and it is gratifying to observe that public-minded citizens everywhere are becoming aware of this urgent need. The American Association of Botanical Gardens and Arboretums contains among its member institutions more than seventy botanical gardens and arboretums. Others exist which are not yet affiliated with this organization. Each year witnesses the establishment of one or more new arboretums. Some of these are but small plots of ground with a few trees surrounding a high school; others boast large acreages and imposing endowments. Regardless of their size and the nature of their scientific, educational or aesthetic potentialities, they should be enthusiastically welcomed as bright new stars in our firmament. For, above all, it should be remembered that an arboretum is essentially a garden—a large one, perhaps, but still a garden. As such it provides, in common with all other gardens, a place for meditation, for the enjoyment of nature in its many moods, for walking among shrubs or under trees, for shuffling dead leaves with one's feet in the autumn. These are matters of the human spirit; these are the intangibles which can not be weighed in an ordinary balance; these are, perhaps, the most important attributes of an arboretum.

If, in all of this, I seem to have conveyed the impression that I consider an arboretum to be an integral and indispensable part of our culture, then I have done what I set out to do.

New Associates

The Arboretum is happy to welcome the following new Associates who have enrolled since June 1960:

Mrs. Donald B. Barrows
Misses Boyd and Ott
Mr. and Mrs. Howard Butcher, III
Mrs. Elizabeth de Berardinis
Mr. D. T. Ebert
Mr. Alan L. Emlen
Mrs. T. Bromley Flood
Mrs. Edward J. Garra
Mrs. Betty Gottlieb
Mr. and Mrs. R. L. Gray, Jr.
Mr. and Mrs. Caspar W. Haines
Dr. F. H. Harvie
Mr. M. G. Herbach
Rev. Louis Hetrick
Mrs. Frederica Johnston
Mrs. Crawford C. Madeira
Mrs. Gary Mattke
Mr. J. Don Miller, Jr.
Miss Rose T. Nardone
Mrs. Ezra K. Nicholson
Mr. Walter M. Phillips
Mrs. B. F. Roland
Mrs. Betty Rotenberg
Mr. Kenneth E. Schroder
Mr. Richard K. Stevens
The Upjohn Company
Mr. Louis Wax
Mrs. Casper Wister
Mrs. Julius Zieget
Mr. Charles A. Zittle

Associates' Corner

Progress in the Medicinal Garden

Back in the 16th century practically every important garden in Europe was essentially a collection of drug plants. This was especially true of the monasteries whose gardens were presided over by monks.

We know from the Badianus Manuscript that many plants were used as drugs in Mexico long before the coming of the white man. Throughout the rest of the Western Hemisphere there was a considerable body of medical lore known to the aborigines.

Even in our neighboring Germantown Dr. Witt, friend of the Kelpius band, established in the early 1700's a special medicinal garden with plants imported from Germany and native herbs which he learned about from the Indians.

Today, with the reawakening of interest in plants as the sources of drugs, several American arboretums and botanical gardens have established medicinal gardens. For the most part, however, these collections contain only plants hardy to the north temperate area. Inasmuch as the great majority of the world's drug plants are of tropical origin it is obvious that these collections are far from complete.

When Dr. Fogg became Director of the Arboretum there was a practically unused greenhouse somewhat apart from the other houses. He conceived the plan of using this house for a living collection of some of the more important tropical drug plants. During the summer months these tender plants were moved outdoors to a trial garden along with hardy native species.

In 1957 the Arboretum was awarded the Founders Fund of the Garden Club of America for the purpose of establishing a representative Medicinal Garden. Dr. Fogg was able to enrich this collection with collections of drug plants he had made in Southern Asia, Mexico, Central America and the West Indies.

For many years the American pharmaceutical industry had been experimenting with synthetic drugs, but the fallacy of some of these substitutes was tragically demonstrated when the supply of quinine and other plant drugs was cut off during World War II.

In the Philadelphia Flower Show in March, 1958, the Arboretum exhibited some of the plants from its Drug Plant Garden. The collection included both native and exotic species and each specimen was artistically labeled by Dr. Li. An attractive legend gave the derivation and therapeutic uses of every plant.

This summer the medicinal collection was established in its permanent location in an area formerly occupied by a conifer nursery. This nursery had become so over-grown that most of the specimens were too large to move. A few exceptional ones were given to the Longwood Gardens; most of the others were "rogued out". The Arboretum's Assistant Superintendent, Mr. John Dourley, then proceeded to design a garden with winding walks and informal beds. utilizing some of the better evergreens as focal points and background material. The result of his brilliant planning is a garden lovely in itself aside from its outstanding interest as a collection of drug plants.

Here, in this skilfully contrived garden, are more than 150 species of drug plants, many of which Mr. Dourley has propagated from seeds. They are largely grouped according to their medicinal properties or chemical constituents; e.g., cathartics, narcotics, stimulants etc., or plants containing gums, resins, alkaloids, and the like. One of the most interesting is *Chenopodium ambrosioides* an old established cure for Hook Worm.

This combined indoor and outdoor drug plant display is now open to the public and is attracting considerable interest. It is of special value to the students in the five medical schools in the Philadelphia area as well as to the students of pharmacy. The Arboretum receives frequent requests for seeds or cuttings for experimental research.

The educational potential and scientific importance of this wonderful collection, unique in the United States, should prove of invaluable assistance in furthering the health of our Nation.

Great praise and credit should go to Dr. Fogg, Mr. Dourley, and the other willing workers who have created this garden. They started it in March and it was a going concern by May.

Marion W. Rivinus

The Cultivated Maples

Hui-Lin Li

The brilliant display of colors in the forests and countryside every autumn is a familiar sight to people living in the northeastern part of North America. Few realize, however, that this autumn splendor is restricted to only certain parts of the world. Such colorful scenery is not seen by residents in the tropics, nor in other parts of the temperate world, such as western North America, where the temperature does not fluctuate widely throughout the year. Actually in the entire world, this gay mantle of fall color may be seen only in temperate eastern Asia, eastern North America and parts of central Europe.

In these three areas, the monthly temperature change is pronounced and a more or less severe winter follows a warm summer. At the approach of winter, the deciduous trees prepare themselves for a long resting period. Foods manufactured by the leaves in the form of sugars are transferred to the woody branches or roots for storage, chiefly in the form of starch, for the growing buds next spring. During this process, chemical substances known as anthocyanins are produced in the leaves of many plants. They may appear red when free acids are present in the cell-sap, and blue when there are no acids.

The red color of the autumn leaves is due to these pigments. The color is more intense in some trees than in others. If anthocyanins are associated with yellow compounds, the leaves will assume an orange tinge. The yellow color is due to the yellow pigments normally present in the chloroplasts, the green granules which manufacture food for the plant in the sunlight. In the dying leaves, the green pigment of the chloroplasts disappears and the yellow color thus becomes visible. Eventually the leaves will dry and turn brown. Thus, in autumn coloration, plant foliage displays all gradations from brown to yellow to red.

Among the trees that show the most brilliant color in autumn are many maples, Sweet-Gum (*Liquidambar*), Sassafras, Tupelo (*Nyssa*), Scarlet Oak, Sorrel-tree (*Oxydendrum*), and also some dogwoods, sumacs, viburnums, and other genera. Most of these genera are especially developed in or restricted in their distribution to eastern Asia and eastern North America. Because of its large number of species and their wide distribution the most important genus of all is *Acer,* the maples.

Acer, The Maple Genus

The maples are among the most widely planted shade and ornamental trees. They are used everywhere, along streets, in parks and in gardens. The genus contains trees of such sizes and types as to meet all requirements, and the great variation in size and form of the species and in the shape and color of the leaves is not matched by any other genus. These characters, together with their ease in transplanting and relative freedom from serious pests or diseases, make these trees highly popular for landscaping purposes.

This large genus contains at least 150 species, distributed over a major part of the Northern Hemisphere from Alaska and Siberia southwards. The genus also occurs south of the equator in the islands of southern Asia—in Sumatra, Java, Celebes and Timor (Mulligan, 1958).

The majority of the species occurs in eastern to southeastern Asia, with 69 in China, 16 in Japan, and 9 in southeastern Asia. There are about 7 species in India and Burma to Tibet, 7 in western Asia, and 13 in Europe. In North America, including Mexico and Guatemala, there are altogether 25 species.

About 68 species of *Acer,* with numerous varieties and forms, are in cultivation in North America. Their most important use is as street trees. Other species are used in rock gardens or on lawns. The autumn coloration of the foliage of many species is the most desirable feature for landscaping. Some species also provide colorful foliage for the spring or summer. A number of kinds are valued also for their ornamental bark (Wyman 1959).

Maple for Autumn Coloration

Many species of maples are cultivated primarily for their autumn color. This color varies from red to red and yellow, orange, orange brown and yellow. The commonly cultivated species with these different colorations are listed below:

Red:

Acer capillipes	*A. mandshuricum*
A. Ginnala	*A. nikoense*
A. griseum	*A. palmatum,* many forms
A. japonicum	
A. leucoderme	*A. rufinerve*
A. tataricum 'Rubrum'	

Red and/or orange and red:

Acer Buergerianum	*A. rubrum*
A. circinatum	*A. saccharum*
A. cissifolium	*A. spicatum*

Orange or orange-brown:

Acer carpinifolium	*A. palmatum,* some forms
A. macrophyllum	*A. truncatum*

Yellow:

Acer campestre	*A. platanoides*
A. cappadocicum	*A. saccharinum*
A. glabrum	*A. tataricum*
A. Mono	*A. tegmentosum*
A. nigrum	*A. Tschonoskii*
A. pensylvanicum	

Yellow and purple:
Acer Davidii

Fig. 30. *Acer palmatum*

Summer Coloration

Besides early spring and late autumn, some maples also provide foliage of varied colors in the normal growing season of the year from late spring through early autumn. A few species are noted for the brightness of their green color, but it is the large number of distinctive colored and variegated forms that are valued for specific ornamental purposes. The greatest variation in color is found in the Japanese Maple, *Acer palmatum,* which we will discuss separately. The following is a list of colored and variegated forms among the other species of the genus.

Colored forms:

Acer Heldreichii 'Purpuratum'	Red beneath
A. japonicum 'Aureum'	Yellow
A. Negundo 'Auratum'	Yellow
A. platanoides 'Rubrum'	Dark Red
'Schwedleri'	Red beneath
A. pseudoplatanus 'Purpureum'	Purple beneath
'Worleei'	Deep yellow
A. velutinum 'Wolfii'	Red beneath

Fig. 31. *Acer palmatum*, a dwarf dissected-leaved form

Variegated forms:

Acer campestre 'Variegatum'	Bordered with white
'Albo-variegatum'	With large white blotches
A. Negundo 'Variegatum'	Bordered with white
'Aureo-marginatum'	Bordered with yellow
'Aureo-variegatum'	Spotted yellow

Fig. 32. *Acer Buergerianum*

Fig. 33. *Acer truncatum*

A. platanoides	'Variegatum'	With large white blotches
A. pseudoplatanus	'Flavo-variegatum'	With yellow blotches
	'Variegatum'	With white blotches
A. rufinerve	'Albo-limbatum	Bordered with white dots

The Japanese Maple

The above lists show the great variation in color of the foliage within the genus. Besides color, variation in leaf form in *Acer* is also very great. The leaves vary from unlobed to lobed and finally dissected forms. (Figs. 30, 31).[1]

All these variations, color as well as form, are highly manifested in a single species, *Acer palmatum*. The Japanese Maple is undoubtedly the most variable species, so far as foliage is concerned, of cultivated trees or shrubs. Mulligan (1958) recognizes more than 70 varieties or cultivars of *Acer palmatum* in North America. While in other ornamental plants, especially in herbaceous ones, variation frequently occurs in flowers, here the ornamental feature depends mainly on the leaves, and sometimes also on the shape of the plant.

This great variation is brought out by intensive cultivation and selection in the Japanese garden. The species has been cultivated there since very early times for the brilliant red foliage in autumn so frequently praised in poetry and depicted in paintings. The Japanese call it Takao Maple because it is especially abundant on the mountain Takao, famous since ancient times for autumn coloration. They use it extensively in their gardens and also as potted dwarf trees (Makino 1951).

The Japanese Maple is a shrub or small tree. It is native to Japan and adjacent parts of the Asiatic mainland. In the Japanese literature there are hundreds of named forms, many of which are now also in cultivation in western gardens. The variation may be either in the color or the shape of the leaves or sometimes in a combination of these two characters.

The leaves vary from 5- to 9-lobed. In some forms, such as the 'Palmatum' group, the leaves are more consistently 5-lobed, while in others, such as the 'Septemlobum' group, the lobes may be mostly 7. The lobes are usually deep and in some forms they may be divided all the way to the base of the blade. The individual lobes may be nearly entire along the margins or more commonly coarsely serrate; in others, they are deeply incised. The extreme forms, such as 'Dissectum' and 'Sessilifolium,' with strongly dissected lobes, have a delicate featherly appearance.

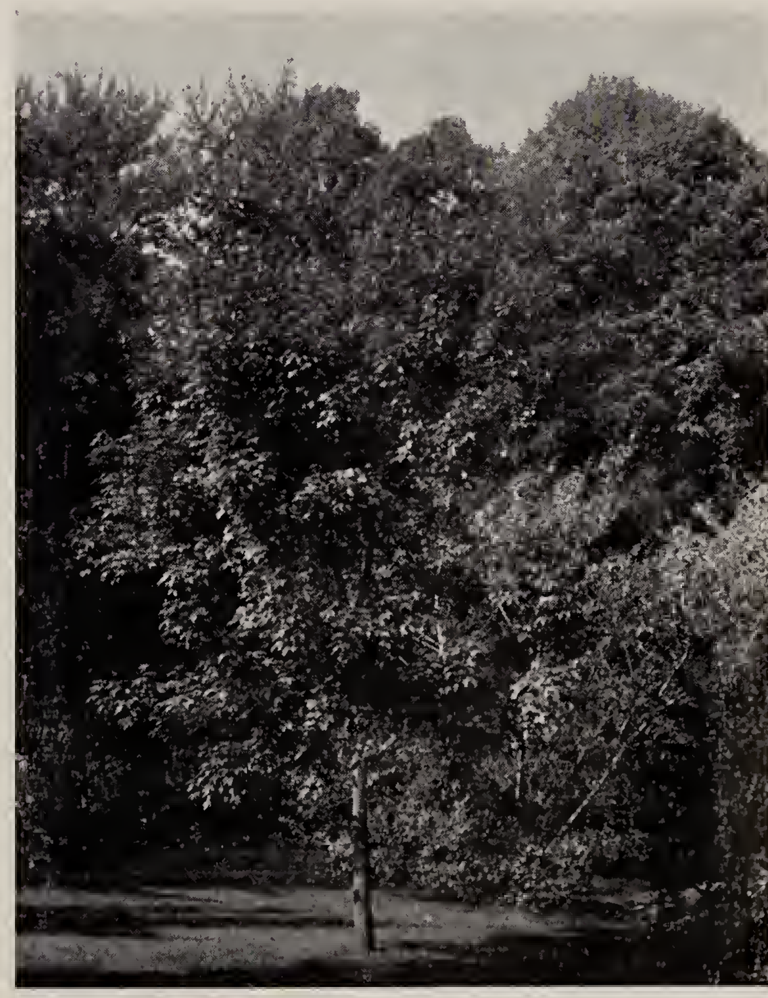

Fig. 34. *Acer Miyabei*

[1] Cover illustration and Figs. 31 and 35 by C. E. Pancoast; others by H. L. Li.

Fig. 35. *Acer Henryi*

In color, the leaves vary from bright green to yellow and different shades of red or purple. They turn yellow to orange or red in the autumn. There are also variegated forms with white spots ('Versicolor'), red blotches ('Bicolor'), pink margins ('Roseo-marginatum'), or various other color combinations. A most becoming form is 'Tricolor' which has the leaves spotted red, pink and white.

Other Asiatic Species

Eastern Asia is the center of development of the genus with about 100 or two-thirds of the total species. (Fang 1939, Matsumura 1954). A number of these have long been in cultivation in their native countries. In Japan, besides *Acer palmatum*, *Acer japonicum* has also been long cultivated. In eastern China, *Acer Buergerianum* has been in cultivation since early times and was also introduced into Japan centuries ago. (Fig. 32). The most commonly cultivated species in northern China are *Acer truncatum* (Fig. 33) and *Acer Mono*.

In the last two centuries numerous other species growing wild in the mountains of China and Japan have been introduced by plant explorers into cultivation. These include some of the most handsome small and medium-sized trees. Some of these have become highly valued in recent years on account of their small sizes and neat appearances, features that are especially desirable for modern landscaping.

From Japan, among the most notable newer introductions are such species as *Acer Miyabei*, (Fig. 34) *Acer rufinerve* and *Acer Tschonoskii*. *Acer cissifolium* and *Acer nikoense* have 3-foliolate leaves and are related to the American Box Elder. *Acer crataegifolium* and *Acer carpinifolium* are distinctive species with unlobed leaves resembling *Crataegus* and *Carpinus* in appearance, respectively.

From Korea, Manchuria and northern China come such species as *Acer Ginnala*, *Acer mandshuricum* and *Acer tegmentosum*. *Acer mandschuricum* is a 3-foliolate-leaved species. These species, originating from a more northern climate, are among the hardiest species in cultivation.

The largest number of new introductions in modern times has come from the mountains of central and western China, the center of development of the maple genus. Among the numerous desirable species, the following are especially notable: *Acer Oliverianum*, *A. Davidii*, *A. griseum* and *A. Henryi*. These are all handsome trees mostly of relatively small size. *Acer Davidii* is a very colorful and distinctive looking tree in the autumn with its foliage turning yellow and purple. The white shiny branches are also conspicuous. *Acer griseum*, the Paperbark Maple, is equally distinctive in the winter with its flaky bark. *Acer Henryi* is a 3-foliolate leaved species related to the Box Elder. (Fig. 35).

The species from eastern Asia now in cultivation are too numerous to mention. Most of these are still of restricted planting and are

Fig. 36. *Acer Mayrii*

Fig. 37. *Acer platanoides* 'Erectum'

found only in arboretums and botanical gardens. Some of the other species which deserve listing are *Acer Mayrii* (Fig. 36), *A. sinense, A. diabolicum, A. longipes* and *A. capillipes.*

Species of the Himalayan Region

Species indigenous to the Himalayan region are generally tender and therefore not suitable for the more strictly temperate climates. These often also extend to parts of China and even to Japan, and the forms or races of these latter varieties are hardier than the typical ones from the Himalayan region.

European and Western Asiatic Species

The Norway Maple, *Acer platanoides*, and the Sycamore Maple, *Acer pseudoplatanus,* native to Europe and western Asia, are among the most widely planted trees.

The exact limits of distribution of the Sycamore Maple (*A. pseudoplatanus*) are difficult to define as the tree has been extensively planted for centuries all over Europe. The native habitat seems to extend from the mountain chain of the Pyrenees to the Alps and the Carpathians in the hilly districts of France, Germany, and Italy to Greece, the Crimea and the Caucasus. In other areas in Europe it is extensively cultivated and flourishes as far north as Norway and Sweden (Elwes & Henry 1906).

There seems to be little variation in the foliage in the wild form, but numerous varieties have arisen in cultivation, especially with respect to the shape of the leaves. A few colored and variegated forms are also known. The best known colored form is 'Purpureum', with leaves purple beneath. The petioles and fruits are often bright red. This variety originated in 1828 in Sander's Nursery in Jersey, England. (Elwes & Henry 1906).

The Norway Maple (*A. platanoides*) has a wider distribution, covering most of Europe and extending eastward into the Caucasus, Armenia and northern Persia. It is indigenous in Norway, Sweden and Finland, and is common in Germany, France, northern Spain and northern Italy (Elwes & Henry 1906). In England it is not native but was introduced in 1683 (Loudon 1838).

The Norway Maple is one of the hardiest trees in cultivation and will grow on the driest and poorest soil. It was introduced into North America in 1870 (Rehder 1940) and is now one of the most widely planted street trees. A number of varieties have arisen in cultivation in Europe including the highly ornamental 'Palmatifidum', the Eagle's-claw Maple, with its elegantly dissected foliage, 'Schwedleri' with its colorful leaves, bright reddish when young, changing eventually to dark green, and 'Erectum' a narrow-pyramidal tree with large leaves. (Fig. 37).

The Hedge Maple, *Acer campestre,* of Europe and western Asia, has also been long cultivated, especially in hedge-rows. (Fig. 38). It runs into many forms. Species from the Mediterranean region, such as *Acer orientale, A. Opalus, A.*

Fig. 38. *Acer campestre*

Fig. 39. *Acer rubrum*

monspessulanum, and *A. Heldreichii* are generally suitable for the milder climates. Species from the Caucasian region, such as *Acer Trautvetterii, A. velutinum* and *A. tataricum,* are sometimes also not hardy in the colder regions.

Species of Eastern North America

A few species from eastern North America are now widely planted not only in America but also in Europe and other continents. Among these, the most notable are the Box Elder, *Acer Negundo,* and to a lesser extent, the Red Maple, *Acer rubrum,* (Fig. 39), the Silver Maple, *Acer saccharinum,* (Fig. 40), and the Sugar Maple, *Acer saccharum.* (Fig. 41). These species were first cultivated in colonial times in the 17th and 18th centuries.

The Box Elder occupies a wide range from eastern to western North America with several geographical varieties and a number of horticultural forms some of which are now favorite ornamental trees. The species is very hardy and drought-resistant and is much used in the northwestern United States for shelter-belts. It was one of the first North American trees introduced into Europe and was cultivated by Bishop Compton in his garden at Fulham near London before 1688 (Loudon 1838). The variegated-leaved form is now a popular garden plant in most European countries.

The Sugar Maple, the source of maple sugar, is much planted, especially in the northeastern States, as a street and shade tree. Formerly it was considered as a wide ranging and variable species, but those forms outside of northeastern United States are now treated as distinct species such as *A. nigrum, A. grandidentatum, A. leucoderme,* etc. The Sugar Maple was introduced into England by Peter Collinson in 1735 (Aiton 1789).

The Silver Maple and Red Maple are also widely cultivated as ornamental trees and both species have developed into a number of horticultural forms in cultivation. The Red Maple, as it inhabited swamps close to the coast, attracted the attention of early travelers in America. It was carried to England as early as 1658 and planted near London in the garden of the younger Tradescent (Sargent 1891). The Silver Maple was introduced into English gardens in 1725 by Sir Charles Wager (Sargent 1891). It grows as well in Europe as in its native country and many varieties have been found in both American and European nurseries.

Less commonly planted are such species as *Acer nigrum* (Black Maple), *Acer leucoderme, Acer spicatum* (Mountain Maple), and *Acer pensylvanicum* (Moosewood or Striped Maple).

Fig. 40. *Acer saccharinum*

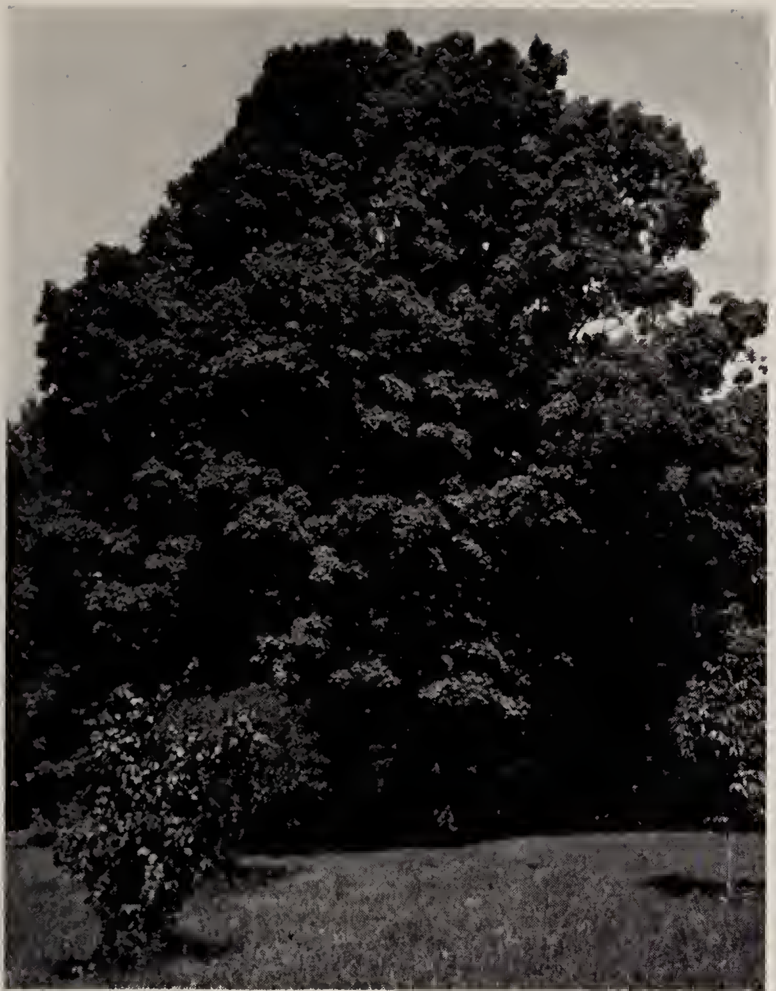

Fig. 41. *Acer saccharum*

Species of Western North America

Species of the western part of North America are generally suitable for the milder climates only. Species that can barely survive in the Philadelphia region include the Oregon Maple, *Acer macrophyllum* and the Vine Maple, *Acer circinatum*. The first is a large tree with very large leaves, attaining to 20-30 cm. across in its native habitat. (See Cover). The latter is a small tree with a wide-spreading habit. The Box Elder, *Acer Negundo*, as mentioned before, is the most widely distributed species of Maple in North America, extending all the way from the eastern to the western part of the continent. There are also local varieties in California, Texas, etc., but these forms are not hardy in colder regions.

The western American species have been cultivated only since the early part of the nineteenth century. Besides those mentioned above, other species are occasionally also planted, such as *Acer grandidentatum*, of the Rocky Mountain area, and *Acer glabrum*, which is widely distributed from Alaska to California.

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Arboretum Activities

(*Continued from Page 34*)

many of the trees and shrubs in the Arboretum's collections, members of the class received instructions in such subjects as the recognition and control of plant diseases, methods of plant propagation and forest genetics. An essential feature of the course was the daily field trips taken around the grounds or to nearby areas of botanical interest.

A second course, coinciding in time with the first, was given to the group of graduate students in the University's Division of Landscape Architecture. The twelve students in this course not only learned how to identify plants but gained some appreciation of the importance of trees and shrubs as elements in design.

Courses for Associates

Of interest to our Associates in the Philadelphia area will be the news that two popular courses in botany are being offered at the Arboretum this autumn.

For some time we have been contemplating the resumption of both classes and public lectures at the Arboretum. It remained, however, for one of our Associates to take the initiative by organizing the first group, the members of whom attended a series of lectures on Plant Ecology last spring.

The response to this course was so gratifying that we have taken steps to continue and amplify our offerings. The charming little studio on the slope below Gates Hall has been renovated and converted into a class room. Two courses got under way the middle of September; one is devoted to Identification of Flowering Plants, the other is an Introduction to Fungi. Thanks to the number of inquiries which have reached us concerning this type of instruction we are hopeful that we may be able to announce a repetition of these or similar courses next spring.

The implementation of such a program requires the cooperation of the faculty of the Division of Biology, the staff of the Arboretum and our Associates. To date the response has been most encouraging.

Operation Sewer

Visitors to the Arboretum during the summer months were dismayed to observe a deep trench traversing the grounds from the Lodge on Hillcrest Avenue to the Native Azalea planting along the Wissahickon Creek. This project was not of our own making, but represented the construction by the City of Philadelphia of a sanitary sewer and a storm water outlet, both of which were authorized by Ordinance of City Council.

It is a pleasure to be able to report that this construction took place with a minimum of inconvenience to the activities of the Arboretum and that the contractor exercised every possible precaution to avoid injury to existing plantings of trees and shrubs.

J. M. F. Jr.

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Insecticides in the 20th Century Environment[1]

George C. Decker[2]

When the first white men came to North America, they found a race of rather primitive men living in reasonable harmony with a relatively stable environment. Under those conditions, this continent supported a population of about one million persons and provided in excess of 2000 acres per capita. Then, as now, literally dozens of insects attacked every crop that grew and neither man nor beast escaped their ravages. In the years that followed, with agriculture on a subsistence basis and a seemingly endless supply of land available, there was plenty for all, and farmers raised only feeble objections to share cropping with the insects. Later, as urban populations increased, each farmer was called upon to meet the food and fiber requirements of an ever-increasing number of individuals and to do so on an ever-decreasing number of acres per capita. This trend continued until at present we have only a little over ten acres per person, seven of which are classified as farm land but only two of which are devoted to crop production.

The early American farmers had little choice but to rely upon nature to control their insect enemies. Then, as losses mounted and the standards of perfection demanded by an increasingly more discriminating consuming public rose, farmers began to clamor for governmental aid and scientific guidance to solve their insect control problems. The early state and federal entomologists were essentially naturalists, and they preached a gospel of biological and cultural insect control methods. For years such measures dominated all entomological endeavor, but finally when natural controls proved wholly inadequate, entomologists reluctantly turned to chemicals, and thus we entered an age of chemical insect control.

The Advent of Insecticides

The large-scale practical use of insecticides is in reality one of the important technological developments of the 20th century. While it is true that numerous nondescript concoctions of lye, lime, soap, turpentine, brine, vinegar, fish oil, and even some tobacco, pyrethrum powder, mineral oil, and arsenic were reportedly used as insecticides prior to the year 1800, effective use of agricultural insecticides had its origin with the use of Paris green to control the Colorado potato beetle in 1867. For the next seventy-five years, arsenical compounds played an ever-increasing role in insect control. Thus, considering the many insecticidal uses for white arsenic, sodium arsenite, lead arsenate, calcium arsenate, and other arsenical salts, it is not surprising to find that from 1939 to 1948 the domestic consumption of white arsenic averaged over 35,000 tons per year. It must be noted also that the arsenicals were not the only chemicals used as insecticides in the pre-DDT era. To obtain a fair estimate of the extent of insecticide usage in the early 1940's, we would have to add about 15 million pounds of pyrethrum flowers, 8-10 million pounds of rotenone-bearing roots and powders, and at least one million pounds of nicotine. Then to all of this we must add literally millions of gallons of petroleum oils, unestimated quantities of tars, cresols, fish oil, and many lesser products.

With the advent of DDT for agricultural use in 1945 and the large array of chlorinated hydrocarbon and organophosphate insecticides that followed in quick succession, many of the older materials suffered a rapid decline in popularity and they were largely replaced by the more effective synthetic organic insecticides. It appears that the actual tonnage of primary insecticidal chemicals produced for domestic consumption each year may not have changed materially. However, with the use of newer and more effective materials at much lower rates of application, the acreage treated has increased several fold in the last decade. Moreover, while prior to the advent of DDT the use of insecticides was for the most part confined to fruit, vegetable, cotton and a few miscellaneous crops of high-per-acre value, they are now used quite extensively on several field crops, pastures, meadows, and forests.

When DDT and at least a dozen other new chemicals became available for general use, a number of competent and distinguished scientists expressed concern that widespread use of

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[1] This article, a condensation from a paper presented at a Symposium sponsored by the Ecological Society of America, appeared in the April 1960 issue of the Bulletin of the American Institute of Biological Sciences. The Director of Publications of that organization kindly granted permission to reprint it here.

[2] Head, Section of Economic Entomology, Illinois Natural History Survey and Illinois Agricultural Experiment Station, Urbana, Ill.

these materials might create a public health problem. Immediately a number of publicity seekers and misguided individuals seized upon the idea that the public was being poisoned, and the country was deluged with an amazing flood of scare stories. Then, as the general public began to show some concern, the witch hunt got underway in earnest. As absurd charges and counter-charges were hurled back and forth in congressional committees and in the press, the scientists settled down to a detailed analysis and factual study of the problem. The public health aspects were reviewed by several scientific bodies, notably the World Health Organization (1, 12), the U. S. Public Health Service (7), and the Food Protection Committee of the National Research Council (4, 6). The general conclusions drawn in each instance were: (a) The large-scale usage of pesticides in the manner recommended by manufacturers or competent authorities and consistent with the rules and regulations promulgated under existing laws would not be inconsistent with sound public health programs, and (b) although the careless or unauthorized use of pesticidal chemicals might pose potential hazards requiring further consideration and study, there was no cause for alarm.

These encouraging conclusions notwithstanding, the fact that insecticides may be misused remains a matter of concern to a considerable segment of the American public. This is true particularly of conservationists who quite correctly insist that many forms of wildlife are subjected to certain potential hazards not shared by man and his domestic animals.

Clarification of Terms

As a prelude to any attempted evaluation of the hazards which may be inherent in the use of insecticides, a few frequently misused terms must be clearly defined. To avoid endless confusion, a careful distinction must be drawn between the terms hazard and toxicity. As the Food Protection Committee of the National Research Council has repeatedly pointed out: "Toxicity is the capacity of a substance to produce injury; hazard is the probability that injury will result from the use of the substance in the quantity and in the manner proposed." Therefore, to be at all reliable, an estimate of the hazard involved in the use of any substance must be based upon a knowledge of its inherent toxicity and upon the details of its proposed use.

It is also imperative to recognize and understand the equally clear-cut difference between the terms acute and chronic toxicity. In general, *acute toxicity* refers to toxic effects (either lethal or profound) occurring immediately after, or at least definitely attributable to, a single exposure by any route of administration, but usually referring to ingestion. *Chronic toxicity* refers to toxic effects resulting from repeated or multiple exposures extending over a period of time and is generally considered to be cumulative in nature.

As noted earlier, the hazards to man and his domestic animals resulting from approved uses for insecticides in public health and agricultural insect control programs have been extensively studied and the general sum and substance of all research in this field have failed to indicate any significant public health hazards. It is generally conceded that safety factors ranging from 10 to 100 fold have been included in most recommendations and at times such factors have been superimposed one upon another until the possibility that an actual hazard may exist is fantastically remote. Whereas man and his domestic animals are afforded much protection by the labeling requirements of the Insecticide, Fungicide, and Rodenticide Act of 1947, which specifies definite time-lapse intervals between insecticide applications and the harvest or consumption of the crop, it is generally recognized that most forms of wildlife can hardly be expected to avail themselves of such precautions. It is also recognized that fish, reptiles, amphibians, and numerous arthropods are more susceptible to insecticide poisoning than are mammals and birds, and in fact there have been a number of cases where fish were killed following the direct or inadvertent contamination of streams and lakes.

As a matter of fact, entomologists, toxicologists, and wildlife biologists alike recognize that some species of wildlife are subjected to hazards not encountered by man or by his domestic animals and thus they present special problems requiring special research attention. For example, it is well known that in general the food consumption of animals is more or less inversely proportionate to their size; thus birds, rabbits, and other forms of wildlife receiving the same diet as much larger animals actually ingest larger amounts of pesticidal chemicals in terms of mg/kg of body weight. Then too, in many treated areas the intake of insecticides by various forms of wildlife may be by ingestion, inhalation, or absorption, and under some conditions certain species may be subjected simultaneously to exposure by all three routes of administration. Finally, it is obvious that relatively small species moving in, around, and under a vegetative cover are subjected to greater and more prolonged exposure than are larger domestic animals standing well above the contaminated vegetation.

In view of the foregoing factors, it is not surprising that there have been numerous instances in which wildlife of varied types has been adversely affected by insecticides. At the same time, the preponderance of evidence to date indicates that such incidents can usually be traced to carelessness, to accidents, to instances of outright experimentation, or to non-agricultural programs involving anticipated hazards. Considering the thousands of tons of insecticides that have been used—and misused—in the control of agricultural pests during the last 50 years, it can be concluded that to date the impact of insecticide usage on wildlife has neither been great nor disastrous. This holds true for orchards, market gardens and cotton fields, which represent the most extensive and intensive agricultural usage of insecticides. Actually, considered from the broad point of view, the impact of agricultural and public health insecticide use on wildlife has been insignificant when compared with many of the other everyday activities of man.

In contrast to these remarkably safe agricultural practices, the existence of some very specialized insect control programs that call for per-acre insecticide dosage rates as much as 5 to 10 times those required in most agricultural uses must be recognized. These do involve calculated risks insofar as wildlife is concerned. The spraying of elms for the control of phloem necrosis or the Dutch elm disease, and the fire ant control program are examples. In such cases the interested parties must, or at least should, with the aid of competent experts, weigh the facts pro and con and then adopt a course of action that will best serve overall interests.

The Balance of Nature

Not infrequently insecticides are accused of upsetting the balance of nature, when in many instances it would be more accurate to say they were used to suppress an organism already out of balance. Actually, man himself has been the primary factor in upsetting the so-called natural balance. When he cleared the forest, plowed the prairies, drained a marsh, or dammed a stream, he altered an entire environmental complex and set up an entirely new set of opposing forces which if left uninhibited would establish an entirely new biotic equilibrium. Presumably it is obvious to all that nature's balance is not a static condition, but is rather a fluid condition changing from day to day, and at the same time constantly moving forward in response to the forces of changing geologic time and advancing culture. Insecticides represent only one minor element of these dynamic forces.

In nature, every living organism is engaged in the most ruthless kind of competition with every other organism upon which its interests impinge. Man is a part of that environment. That he has been eminently successful is evidenced by the fact that the human population of this country has risen from less than one million to over 170 million in some fifteen to twenty generations. It now becomes apparent that to clothe and feed this vastly increased population, man must maintain his position of dominance, and our agricultural production must continue to increase even at the expense of the further displacement of native plants and animals. It may be news to some that these pressures are now intensified by the fact that we have at last absorbed and brought into production most of the lands suitable for agricultural production. As a matter of fact, 1954 marked a turning point in our history because then for the first time the withdrawal of agricultural land for use as home or industrial sites, airports, and highways exceeded the land reclaimed, and the number of acres in farms showed a decline. While America is pleasantly blessed or, as some say, plagued, by overproduction, with populations increasing and the area of farm land trending downward, it will be a matter of only a few years until agricultural scientists and farmers will have to make ever-increasing use of new advances in agricultural technology, including even greater use of insecticides and other pesticides, to meet the nation's food and fiber requirements.

Population and Land Use

In a recent discussion of population dynamics and land use problems, H. B. Mills (9) said, "When we think of the future of recreational lands in all of this competition for land use, we cannot get away from zoning. We must think of areas where people will live, where they will work, where their roads will go, where they will produce their food, where they can find outdoor relaxation, and where wildlife can live and prosper. We may not like the idea of such regimentation; it will be an expression of restricion of personal freedom due to increased population density."

In 1954, the United States Department of Agriculture (11) estimated that to offset the pest losses in agricultural production, an extra 88 million acres must be cultivated, and that losses subsequent to harvest equal the production of an additional 32 million acres. Is it not possible that the benefits to be derived by diverting these acres to soil and wildlife conservation would far exceed any forseeable damage that might accrue from the approved use of insecti-

cides? The recent amendment of the duck stamp law is a step in the right direction, but this is apparently not enough. There is still some talk of a land bank, and the disposition of submarginal lands is still an open question. But 10 years hence may be too late. Is it possible that while dissipating our energies pondering potential hazards that may never materialize, we are missing the opportunity of a lifetime to secure and preserve an adequate representation of our native fauna and flora to be forever maintained in suitable conservation and recreational areas?

Difficulties of Evaluation

Those familiar with the excellent reviews on wild-life-insecticide relationships by Brown (2), Rudd and Genelly (10), and Cope and Springer (3) must be aware of the fact there is a considerable volume of excellent field and laboratory research, much of which tends to pinpoint areas of considerable concern where further research is needed. Nevertheless, at times it is difficult to evaluate properly many of the criticisms directed against insecticides and certain insect control practices. For example, some authors frequently note that a certain insecticide such as aldrin or heptachlor, is 5, 10, or even 20 times as toxic as DDT and then, after commenting in a matter-of-fact way that it may persist for several years, they imply that the hazard involved is tremendous, when actually the hazard may be insignificant because the dosage is low and the residue is rapidly lost. All too often the results of some laboratory or field experiments are cited as if they were typical of conditions to be encountered following the legitimate use of the insecticides without any further detail. Some attempt should be made to distinguish between the treatment of a million acres of cotton with X insecticide at 2 ounces per acre, and an equal area of marsh or timberland at 2 pounds per acre. A million acres is a lot of ground, but, after all, it represents considerably less than 1/10 of one per cent of the land area of the United States.

Pre-testing Insecticides

It is frequently asserted that new insecticides are introduced and released for large-scale insect control operations without adequate pre-testing, but apparently these critics are unaware that as early as 1948, Dr. A. J. Lehman (8) clearly and with amazing accuracy set forth the toxicological characteristics of DDT and related compounds. Then, too, the very fact that the review by Rudd and Genelly (10) contains a bibliography in excess of a thousand titles would indicate that the characteristics of insecticidal chemicals are not entirely unknown. As a matter of fact, there are experts who would testify that few if any chemicals known to man have undergone the toxicological scrutiny to which DDT has been subjected. It is true that all questions and problems have not been entirely resolved "beyond a shadow of a doubt," but that is not surprising, for after all, science is seldom if ever static and there are few instances where a scientist can claim he has established all of the answers finally, conclusively, and irrevocably.

Actually, there are many problems related to insecticidal chemicals that cannot be anticipated or resolved in advance in any laboratory or small plot experiments. As a matter of fact, in establishing the principles to be observed in the evaluation of new insecticides, the Food Protection Committee of the National Research Council (5) acknowledged this basic truth when it said, "Complete knowledge of many factors pertaining to pesticide usage, performance, and ultimate safety can be developed only through actual use in large scale performance tests. Hence, any system proposed for regulating the distribution of new materials should provide for their orderly release with recognized steps between strictly controlled small plot experiments and full scale commercial operations." This being the case one must anticipate certain adverse reactions and responses in the early large-scale usage of a pesticide. The correct procedure is to make sure such instances are detected and corrected as soon as possible. While the occurrence of such incidents is disturbing and regrettable, it seems reasonably certain the adverse effects will rarely if ever be disastrous or permanent.

Not infrequently the wildlife specialist and the conservationist feel that they are placed at a disadvantage in presenting their case because in a large degree the values with which they deal are intangible, and thus the reconciliation of divergent points of view which often elicit strong emotional responses becomes doubly difficult. Even here, there are at least some entomologists who can lend a sympathetic ear, for insect control also has its intangible considerations which can likewise induce violent emotional eruptions.

Many of the most dreaded diseases of man are insect-borne, and there are those who regard the continued control of insect disease vectors as essential to the maintenance of successful public health programs. The hundreds of phone calls that besiege public health officials when nuisance mosquitoes become annoying lend ample testimony to the public interest in and the demand for local mosquito control programs.

Fig. 42. Elm trees killed by Dutch elm disease. Tree lovers insist this should not have been permitted; bird lovers insist trees should not be sprayed if birds and other wildlife may be adversely affected. Photo, Illinois Nat. Hist. Survey.

Then, too, a large segment of the American public is profoundly interested in the protection of shade trees, ornamental plantings, and forests. Literally thousands of individuals, recalling with profound regret the demise of the chestnut tree because no effective disease control measures were available, vociferously demand that every possible effort be made to assure that the same fate does not befall the American elm, the most common and perhaps the most beloved shade tree in America. In the battle for the elms we approach the tragedy of civil war, for here we have entomologist pitted against entomologist, conservationist against conservationist, and neighbor against neighbor. Last but not least, the fact that the Congress of the United States and a score of state legislatures, normally reluctant to appropriate funds, except in response to great pressure, have approved plans and appropriated funds for several large-scale insect control programs, testifies to the public's interest in phases of insect control which do not affect its diet and only indirectly affect its pocketbook.

Considering All Sides

Any fair and impartial appraisal of the impact of insecticides on wildlife must give equal consideration to both the good and bad side-effects that may occur, and if we are to be honest we must look for the good as diligently as we look for the bad. Unfortunately, harmful side-effects are usually readily apparent, whereas indirect beneficial results are apt to pass totally unobserved. Nevertheless, the impartial observer may be pardoned if he considers the loss of a few song birds attributable to the spraying of elm trees less harmful than the permanent loss of such trees, with the accompanying disappearance of nest sites. (Fig. 42)

Unfortunately, the ultimate effect of insecticide usage on animal life cannot always be measured in terms of initial mortality of individual species. In reality it must reflect and encompass the long-term effects on both plant and animal life. Since the latter is largely dependent upon plants for both food and shelter, is it not possible that the destruction of timber, range vegetation, or cultivated crops by insects may produce a chain reaction that will ultimately affect all of the forms of life in the area?

Conclusions

There is no question but that the future food, fiber, and public health needs of this country will assure the continued, if not, indeed, the greatly expanded use of insecticides for generations to come.

Despite the widespread use of insecticides totaling billions of pounds in the last decade, fearful predictions that the large-scale usage of modern pesticidal chemicals would seriously upset the balance of nature and result in disastrous losses of wildlife have not been realized. To quote from the most comprehensive and complete study of the problem (10), "Considered in its broadest scope, at the present time pesticides seem to be only minor influents in nature compared to other factors in land and water development and use."

Favorable results notwithstanding, the many diverse and complex problems of wildlife conservation in a chemical world must be kept under continued surveillance. Particular attention should be devoted to the welfare of rare species of restricted habitat, to the impact of new chemicals as they are introduced, and to pest control programs involving the widespread application of insecticides over large contiguous areas.

Since most of the unfortunate incidents, problems, and differences of opinion that have arisen or are likely to arise, involve insecticide usage (unintentional or otherwise) that was not covered by label approval, it appears that the solution of the problem at hand rests in the detection, isolation, proper evaluation, and eventual elimination of malpractices rather than indulgence in wholesale condemnation of insecticides and insecticide usage *per se*.

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Ilex serrata

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Donor	$500.00		

Arboretum Activities

The Staff

On October 1 the Director represented the Arboretum at the dedication of the Climatron at the Missouri Botanical Gardens in St. Louis. On October 4 he spoke to the Comstock Society on "Fall Color at the Arboretum" and on October 11 he gave an illustrated lecture entitled "A Botanist in India" to the Natural History Society of Delaware in Wilmington.

Dr. Li was one of the principal speakers at the Pennsylvania Garden Symposium on October 13. The subject of his address was "Japanese Gardens and Bonsai and their application to the American Home." On December 5 he spoke on "Plants of the Bible" at the meeting of the Germantown Horticultural Society.

Dr. Allison participated in a program of in-service meetings for high school science teachers held at Radnor High School on October 10 and at Kennet Square High School on October 11. On each of these occasions she gave a two-hour lecture demonstration on an important area of biology. On December 8, Dr. Allison spoke to the Gloucester County Nature Club at Wenonah, New Jersey, on the topic, "Dividends from the Fungal World."

(Continued on Page 70)

The Deciduous Hollies

John M. Fogg, Jr.

To many persons the word "holly" conveys the impression of a plant with thick, spiny evergreen leaves and bright red berries. Our well known American Holly, *Ilex opaca* Ait., and the almost equally familiar English Holly, *I. Aquifolium* L., both fit this definition, as do a few other species, such as *I. cornuta* Lindl. and *I. Pernyi* Franch. To some, however, it comes as a shock to learn that our common Inkberry, *I. glabra* (L.) Gray, is also a holly, although its leaves are without spines and its berries are black rather than red. The same is true of the Japanese *I. crenata* Thunb. and a number of other species.

In all of the forgoing hollies the leaves are leathery and persistent throughout the year. There is, however, within the genus *Ilex* a group of species which are even less "holly-like" than Inkberry. Their leaves are membranaceous, rather than thick or coriaceous, and they lose their foliage with the coming of winter. Nevertheless, by the structure of their flowers and their fruit these, too, deserve to be considered hollies, although the common names which they bear usually obscure this fact.

It is entirely appropriate that the evergreen hollies should over the years have claimed the major share of attention on the part of growers. However, the deciduous forms are well worthy of a place in any collection of ornamental shrubs, and it is the purpose of this account to emphasize the merits of some eight or nine species which are either in cultivation at the Morris Arboretum or are known to be hardy in the Middle Atlantic States. The following species belong in this category: *I. verticillata* (L.) Gray; *I. laevigata* (Pursh) Gray; *I. geniculata* Maxim; *I serrata* Thunb.; *I. Amelanchier* M.A. Curtis; *I. longipes* Chapm.; *I. collina* Alexander; *I. decidua* Walt.; and *I. montana* T & G.

Fig. 43 *Ilex serrata*, male flowers

Fig. 44 *Ilex serrata*, female flowers

Range of Variation

The deciduous hollies vary in size from the low-branching shrubby aspect of *I. Amelanchier* to the tree-like habit of *I. decidua* and *I. montana*.

The foliage of most of them is membranaceous and somewhat veiny, although the leaves of *I. decidua* are dark green, lustrous and rather thick.

As is the case in all species of hollies, the small white or cream-colored flowers are almost always unisexual, and a single plant bears only one kind of flowers. This means that an individual specimen is either male (staminate) or female (carpellate), a condition which is called dioecious.

The male flower bears functional stamens surrounding a shrunken or abortive ovary (Fig. 43),[1] whereas in the female flower the ovary is well developed and the stamens are small and function-less (Fig. 44).

[1] Illustrations by Drs. Patricia Allison and H. L. Li.

There is, apparently, no known method of determining the sex of any species of *Ilex* until it blooms, but fortunately the carpellate flowers of many species are receptive to pollen from the male flowers of the same or other species. For example, all of the specimens of *I. verticillata* growing at the Morris Arboretum appear to have female or carpellate flowers and yet there are enough male plants of other species of *Ilex* in their proximity to insure an abundant supply of brilliantly colored fruit each autumn.

The so-called berries of hollies are, more properly, berry-like drupes with several nutlets. Those of the deciduous species are often extremely showy; they vary in color from red or scarlet to yellow or white and in size from a diameter of less than a quarter of an inch (4-5 mm.) in *I. serrata* to about three-eights (1 cm.) in *I. montana*. Few shrubs or small trees are more attractive in the fall than a fully-fruited specimen of Black Alder (*I. verticillata*) or Possum Haw (*I. decidua*).

Geographical Distribution

As is true of a great many groups of woody plants, the genus *Ilex* has its main centers of distribution in the eastern United States and southeastern Asia. (Fogg 1942). It is true that the so-called English Holly (*I. Aquifolium*) is native to the British Isles, western and southern Europe, northern Africa and central Asia and that the Azores Holly (*I. Perado* Ait.) occurs in southern Spain, the Azores, Madeira and the Canary Islands. However, most of the remaining representatives are indigenous either to eastern temperate North America or to Southeastern Asia including the Japanese archipelago and certain subtropical areas to the south.

With respect to the deciduous hollies here under consideration, the above geographic affinities are well illustrated: *I. geniculata* and *I. serrata*, both natives of Japan, are closely related to our eastern American *I. verticillata* and *I. laevigata*. *I. macropoda* Miq., which is often considered to be merely a smaller fruited variety of the American Mountain Holly (*I. montana*), is indigenous to Japan, while the closely related *I. macrocarpa* Oliv., which is apparently not hardy in our area, is a native of central China.

Classification

The deciduous hollies belong to the subgenus PRINOS, which is characterized by having its flowers either solitary in the axils of the leaves or fascicled with the leaves on short truncated lateral branchlets. This subgenus is further divided into two sections: Euprinus and Prinoides.

In the section Euprinus the flowers are borne in the axils of the leaves and the nutlets of the fruits are smooth on the back. Here belong: *I. verticillata*, *I. laevigata*, *I. geniculata* and *I. serrata*.

Fig. 45 *Ilex verticillata*

In the section Prinoides the leaves as well as the flowers are usually fascicled on short lateral spurs and the nutlets are ribbed or striate on the back. Also, the fruits are generally larger than in the preceding group. To this section belong: *I. Amelanchier*, *I. longipes*, *I. collina*, *I. decidua* and *I. montana*.

Section Euprinus

Ilex verticillata (L.) Gray. Black Alder, Winterberry. A shrub seldom more than 10 feet (3 m.) tall which occurs in swamps, woods and thickets from the Gulf of St. Lawrence west to Minnesota and south to Florida and Louisiana. The leaves of this species are elliptic or obovate, single or doubly serrate on the margin, and pubescent on the lower surface. The flowers are short-stalked and the bright red fruits are borne in tight clusters. The species is undoubtedly one of the most spectacular of our brilliantly fruited native shrubs in the fall of the year (Fig. 45).

Although in no way related to the alders this plant doubtless owes one of its common names, Black Alder, to the fact that its leaves often turn brown or blackish after the first frost. Another common name Winterberry may seem to be a misnomer in areas where the birds rob the shrubs of their fruit long before the coming of frost.

At the Arboretum we have several fine specimens of this species in the Langstroth Bee Garden, in the old holly planting on the south slope and near the Swan Pond. Recently we have established a special grouping of deciduous hollies on the slope below the Gates Building and have selected four plants of *I. verticillata* as the basic element against which to display the other members of this series.

Several varieties of *I. verticillata* have been described, but the only one which seems worthy of recording for horticultural purposes is forma *chrysocarpa* Robins, in which the drupes are yellow rather than red.

Ilex laevigata (Pursh) Gray. Smooth Winterberry. This species is closely allied to the preceding in habit, mode of growth and the character of its foliage. However, the leaves are less pubescent beneath, the staminate flowers are borne on long, slender pedicels, and the drupes tend to be orange-red or scarlet instead of reddish. According to Wyman (1956) this species is capable of setting fruit without pollination. No doubt this faculty, which is known as parthenocarpy, is possessed by other species as well.

Smooth Winterberry is a handsome shrub in our coastal plain swamps and wet thickets from Maine to northern Georgia. It succeeds well in ordinary garden soils of a somewhat acid nature and is richly deserving of a place in any shrub collection. A form with yellow fruit has been described.

Ilex geniculata Maxim. First introduced into this country in 1894 by Dr. C. S. Sargent, Director of the Arnold Arboretum, who collected the seeds in Japan. This species bears a strong resemblance to the two preceding ones, but differs in its longer more acuminate leaves and in the much longer and more slender fruit-stalks (peduncles). The latter may bear one to three drupes and are several times as long as the petioles. The fruits are bright red. Several young plants of this species were moved into our deciduous holly collection two years ago and may be expected to produce berries in another year or two.

Ilex serrata Thunb. Finetooth Holly. Also a native of Japan, this species develops into a well-shaped shrub usually about 6 to 7 feet (approximately 2 m.) tall. The leaves which are dull green above are sharply serrulate on the margins and densely pubescent on the lower surfaces (Figs. 43 and 44).

Although the corollas of most species of *Ilex* are white or creamy, those of *I. serrata*, especially the staminate ones, are delicately flushed with lavendar.

Few hollies are more fully fruited than this one; Figure 46 portrays a branch of this species photographed in the Arboretum on September 23. The drupes, although small, are of a rich deep reddish color. Unfortunately for humans, the fruit is also attractive to birds and a full-grown shrub may be completely divested of its crop of berries within three or four days after they mature. Both white and yellow fruited forms have been described in this species.

Section Prinoides

Ilex Amelanchier M.A. Curtis (*I. dubia* (G. Don) B.S.P.) A shrub or small tree which occurs sparingly in swampy woods from southeastern Virginia to Georgia and Louisiana. The blunt, oblong leathery leaves must have suggested the foliage of the Shadbush (*Amelanchier*) to

Fig. 46 *Ilex serrata*

Fig. 47 *Ilex decidua,* fruiting branch

the author. The large scarlet drupes are borne on long, thread-like pedicels.

Although this species is not in cultivation at the Morris Arboretum, is has been successfully grown only a few miles from here by Mrs. J. Norman Henry at Gladwyne, Pa.

Ilex longipes Chapm. Georgia Holly. This relatively little known Holly is found in a variety of habitats from West Virginia and Tennessee to Florida and Louisiana. It is a large shrub with thin elliptic to lanceolate leaves which are remotely serrate on the margin, smooth above and hairy on the midrib beneath.

Both types of flowers are unusually long-pediceled (giving the plant its specific name), the female somewhat more so than the male. The large globose fruits are red or, in the plant which has been called forma *Vantrompi* M. Brooks, yellow. This will be further discussed under the following species.

Our single specimen of *I. longipes* at the Morris Arboretum is a gracefully branching shrub about 13 feet (4 m.) tall and almost as wide. Since it is a male plant it is impossible to report on the characteristics of its fruit.

Ilex collina Alexander. In describing this species from West Virginia, Alexander (1941) characterized it as a small tree 3-4 m. tall with thin, glabrous, broadly elliptic to obovate leaves, their margins finely serrate with teeth abruptly ending in large blands. The bright red drupes were said to be 7-8 mm. in diameter and borne on pedicels 10-15 mm. in length. According to the author, this species is related to *I. longipes* from which it differs in its more strongly ridged nutlets and to *I. monticola* (*montana*) in the longer pedicels of its fruits.

Woods (1951), in reviewing the status of *I. collina,* had this to say, "In 1936, A. B. Brooks reported the discovery of *Ilex longipes* Walt. in West Virginia. Several years later, Maurice Brooks (1940) reported the discovery of a yellow fruited form of this species and subsequently named it forma *Van Trompii.* In 1941, E. J. Alexander, who had been studying plants of the same species but from a different locality for a number of years, named the species *I. collina.* Following this [in 1944] Core and Davis transferred the yellow fruited form to this species. In the eighth edition of Gray's Manual of Botany (1950), Fernald regarded the long-pediceled holly of Virginia and West Virginia as being identical with *I. longipes.* There are several reasons why the latter is not a satisfactory treatment, and the writer suggests that Alexander's name be used.

"As Alexander has shown, there are differences between *I. longipes* and *I. collina* in the marginal spines and lower leaf surface and in the sepals. Because of the limited number of specimens at his disposal for study, he failed to see the range of variation in the striation of the nutlets. The writer, who has been able to study a larger number from a wider geographical range, finds that the nutlets may be much more smooth than stated in the original description of the species (Alexander 1941).

"The affinities of this species lie with *I. verticillata* rather than with *I. montana,* as thought by Alexander. The deeply impressed venation approaches that of *I. verticillata* rather than *I. montana.* This is also true of the thickness and number of marginal teeth of the leaf blades and the shape of the calyx lobes."

It appears that considerable confusion still exists concerning the status of *I. collina.* Dr. A. J. Sharp, Professor of Botany at the University of Tennessee, who knows this plant in the field, tells me that he is unable to separate it from *I. longipes.* Unfortunately, due to repairs now in progress at the New York Botanical Garden,

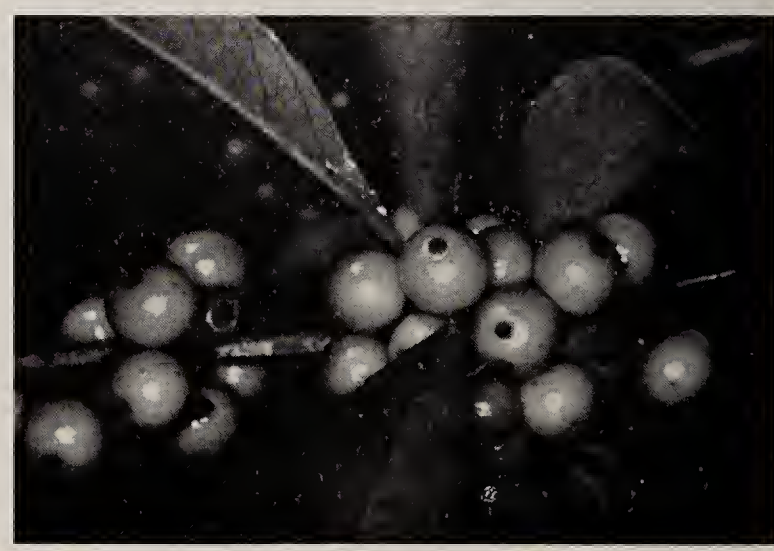

Fig. 48 *Ilex decidua,* close-up of fruit

Fig. 49 *Ilex montana*

it has been impossible to examine the type of this species which is in the herbarium there. Further discussion of this problem will therefore have to be deferred. In the meantime, we are maintaining Alexander's species since it is in cultivation under this name. Thanks to the generosity of Mr. Henry Hohman, of Kingsville Nursery, Maryland, we have recently received a fine female specimen of this species. Its performance will be followed here with keen interest.

Ilex decidua Walt. Possum Haw. In some ways this is the most showy of all of the deciduous hollies. It is a tall shrub or small tree up to 30 feet or more (10 m.) which inhabits thickets, low woods and bottomlands from Maryland to Florida and Texas. The oblong-cuneate, crenately-margined leaves are dark green and lustrous above, somewhat pale and slightly pubescent beneath. The globose drupes, which are 7-8 mm. in diameter, are orange or scarlet and are usually borne in such profusion as to create the illusion of dense verticels (Figs. 47 and 48).

When not denuded by voracious birds this species is said to retain its fruit well throughout the winter. Here at the Arboretum, however, the berries are seldom allowed to persist after the middle of October.

Ilex montana T. & G. (*I. monticola* Gray) Mountain Holly, Mountain Winterberry, Large-leaf Holly. This is a tall shrub or small tree which may attain a height of 35 to 40 feet (12 m.). It is a denizen of rich wooded slopes and uplands from New York to Georgia and Alabama. The large membranaceous leaves of this species are sharply serrate on the margins, usually glossy above and either smooth or pubescent beneath. (Fig. 49) The staminate flowers are on rather long (1-2 cm.) stalks or pedicels, while those of the carpellate ones are distinctly shorter. The fruits, which are about three-eighths of an inch (1 cm.) in diameter are orange-red or scarlet and against the background of the large lustrous leaves they produce a fine effect in early autumn. The nutlets are conspicuously striate on the back.

Mountain Holly is a polymorphic species and a number of varieties have been recognized; of these the most wide-spread in our area is var. *mollis* (Gray) Britt., in which the lower surfaces of the leaves are soft-pubescent, at least along the nerves.

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History of the American Association of Botanical Gardens and Arboretums

John C. Wister

The AABGA owes its organization largely to the enterprise and energy of one man, Mr. Robert Pyle of West Grove, Pa. For some twenty years, beginning in the early 1920's, Mr. Pyle had been chairman of the committee on botanical gardens and arboretums of the American Association of Nurserymen, and in that capacity had been largely responsible for the preliminary work which resulted in the establishment of the National Arboretum in Washington.

Mr. Pyle was an indefatigable traveler and attender of meetings. In the course of some twenty years he visited every part of this country to attend meetings of various nursery and florist organizations and at the same time made himself familiar with the botanical gardens or arboretums in each area. His almost yearly trips to Europe to get new roses gave him an opportunity to visit most of the famous botanical gardens in England, Scotland, Ireland, France, Belgium, Holland, Italy and Spain.

It is quite evident therefore, that he had a background of information possessed by no other individual in our generation. While he was actively promoting the idea that he then called "United Horticulture", and which has now resulted in the formation of the American Horticultural Council, now merged with the American Horticultural Society, he saw the need of bringing the various arboretums and botanical gardens in closer touch with each other. Quite naturally he spoke about this to many officials in these institutions and finally in 1940 arranged for a meeting in Cleveland.

There is apparently no exact record of the first individuals with whom he worked in this effort, but it is quite evident that Donald Wyman and Henry Teuscher were two of the leading people on whom he relied. They met with him before the organization meeting, and the group also included Nelson M. Wells of the Cornell University Arboretum, Dr. Harold A. Senn, Dominion Arboretum and Botanical Garden and Department of Agriculture, Ottawa, Canada, and G. D. Cooper of the Holden Arboretum, Cleveland, Ohio.

A report of this meeting supplied by Dr. Henry T. Skinner states that Dr. Wyman acted as chairman, having been appointed in 1939 by the American Institute of Park Executives. He reported that 155 letters had been mailed to institutions listed in the directory of the American Association of Nurserymen and that 45 replies had been received. About half had promised to attend the meeting and the other half, while unable to attend, had expressed willingness to support the project.

The terms under which the new organization might join as a chapter of the American Institute of Park Executives were explained, with the privileges and duties appertaining to this. It was urged that the National Arboretum should become the coordinator of all arboretums in the country.

This committee unanimously agreed that there should be an organization and that the membership should be based on individuals and not on institutions. Until the new organization could develop strength to stand alone, it was considered best to affiliate with the American Institute of Park Executives, although affiliation with the American Association for the Advancement of Science and the American Association of Nurserymen was seriously considered. Proposed By-Laws were presented which were based on those of the American Association of Zoological Parks and Aquariums which had already become affiliated with the American Institute of Park Executives.

The organization meeting of the AABGA was held in the Hotel Statler, Cleveland, on September 25, 1940, with Dr. Wyman presiding and Mr. Pyle acting as temporary secretary. A breakfast meeting was attended by nearly 40 people who approved and signed the revised By-Laws as drafted the evening before.

Mr. Pyle outlined briefly the history of the growth of the arboretum idea in America. He stated that the study of his committee of the American Association of Nurserymen had led to the conviction that the various institutions had developed in too isolated a manner. Many problems had made it evident that cooperation would be advantageous, particularly for assistance in developing new arboretums in those regions which needed them and which at present did not have them. Nelson Wells, the second speaker, outlined many possible activities for the new association. Henry Skinner spoke about the advantages of having certain institutions specialize along certain lines as on certain plants. He also suggested that the various arboretums

should supply complete lists of the plants which they grew.

John C. Wister spoke of the difficulties of getting desirable new ornamental plants into commerce and described the methods that had been carried on for many years with fruits by the New York Fruit Testing Association.

Mr. Pyle followed this with remarks concerning the different types of nurseries best fitted for undertaking the introduction of such new material and said that he felt that the Nursery Association as well as the U.S. Department of Agriculture could deal more practically with our new association than with individual arboretums.

Samuel Baxter, Superintendent of Fairmount Park, Philadelphia, related the experience of Mr. A. E. Wohlert in bringing about the introduction of the Japanese Cherries into commercial nurseries in this country.

Following the breakfast session additional persons joined the meeting and at that time Dr. E. D. Merrill, Director of the Arnold Arboretum, spoke on the great development of horticulture which had been aided by the introduction of new plants by the Arnold Arboretum, and particularly about the introductions of Professor C. S. Sargent and Dr. E. H. Wilson. He mentioned the great difficulties with plant exportation due to troubled world conditions.

Dr. C. Stuart Gager, Director of the Brooklyn Botanic Garden, spoke on "Popular and Scientific Horticulture in a Botanic Garden." He mentioned compiling a book on arboretums and botanical gardens of the world, about 550 in all, of which 122 had been in the United States; 102 of these were in existence in 1940; 17 inaugurated before 1900 had been discontinued and 3 inaugurated since 1900 had been discontinued. He felt that before 1900 there were very few institutions in this country really deserving of the name arboretum or botanical garden, and gave definitions, distinctions and statistics about these. He also mentioned the garden instruction of school children at the Brooklyn Botanic Garden.

At the formal organization meeting which then followed, Dr. Wyman was made chairman and Mr. Pyle secretary, and a committee was set up consisting of Dr. Wyman, Henry Teuscher, Nelson M. Wells, Harold A. Senn, H. T. Skinner, C. E. Godshalk, G. D. Cooper, and Robert Pyle, to work out the preliminary plans. The following officers were elected by this group: Dr. Donald Wyman, Chairman, Dr. Henry T. Skinner, Vice-Chairman, Dr. C. E. Godshalk, Secretary, and two directors, Dr. C. Stuart Gager and Henry Teuscher.

The notes of this meeting do not speak of other directors or of the term of office of directors, but it is believed that Mr. Stanley M. Rowe of Cincinnati was quite soon added to the list of directors.

These officers carried on the activities of the organization for the next six or seven years, but owing to the war very few meetings were held.

The new organization had very hard sledding in the beginning. This is easily understood because some fifty or sixty members scattered across the country could not get together often for meetings. Indeed, it was not even practical to hold many executive committee meetings, and most of the work was done by correspondence. Here the greatest credit is due to the first chairman and the first secretary, who carried so much of the burden.

In addition to the difficulties of distance there had been differences of opinion as to the best way to carry on an organization of this character. Those who organized the Association felt it wise to put it under the temporary wing of the American Institute of Park Executives and several of the AABGA annual meetings were held in connection with the meetings of this great organization. While this gave members an opportunity to meet many of the park executives of the country, our little organization was completely lost in meetings of many hundreds of people, with three and four day programs of all-day sessions allowing no time for our own small group. The great expense of meeting with the big organization was also a handicap and members complained of paying the $20.00 registration fee for which they got nothing. Therefore, after several inconclusive polls of the membership, the officers and executive committee in 1950 decided to sever the connection with the Institute and go it alone.

During the period of affiliation, the magazine "Parks and Recreation" published most complete notes concerning both the AABGA activities and those of its member institutions. The Newsletter inaugurated in 1950 has been a very small substitute for this splendid publication, but it is perhaps more suited to our needs and will, it is expected, grow with the organization.

The membership list today contains 164 names, most of them representatives of botanical gardens, arboretums and parks. Included among our members, also, are landscape architects, nurserymen, botanists, and amateurs who are actively interested in the objectives of the organization.

The Association has sponsored the following publications:

Lilacs for America. Edited by John C. Wister. 1942; revised 1943 and 1953.

Crab apples for America. Edited by Donald Wyman. 1943; revised 1955.

Maples cultivated in the United States and Canada. B. O. Mulligan. 1958.

Since 1951 Mr. Carl W. Fenninger, President of the John J. Tyler Arboretum, has been Secretary-Treasurer of the organization. It is largely due to his untiring energy and loyal devotion that the AABGA has made such tremendous strides during the last decade.

In spite of early discouragements, those who helped found the organization and who have stuck to it through the years, feel that it has already performed an important function in the lives of the institutions which it represents and that it has unlimited opportunities for usefulness in the future. Many of its members, indeed, feel that if it had done nothing else than to get the representatives of the different institutions together so that they might know each other, the whole effort would have been worth while. We firmly believe that the AABGA has an important future if its members will continue to support the work which is so much needed.

Associates' Corner

A Dedicated Man

John Tonkin was born in Penzance, Cornwall, England on October 24, 1887. A true Cornishman. Before coming to the United States he took the precaution of marrying Margaret Williams on May 10th, 1913 and they arrived in this country May 26th, 1913.

After a short interval with the Newbold family, Mr. Tonkin came to Miss Morris on July 14th, 1913. He has watched "Compton" develop from a handsome private estate into the lovely and valuable Arboretum of today. Many of the trees and shrubs are like his own children. He attended their birth and glories in their stalwart attainments.

When the news that the City of Philadelphia was going to run a sewer pipe line through the Arboretum, great was the woe among its many lovers. Not so John Tonkin. In true Cornish fashion he did not waste effort trying to buck the inevitable, but turned all his energies into making the best of a grim situation.

First he diplomatically set about cultivating the friendship and cooperation of all the foremen and superintendents who would be connected with the job, gained the confidence of the workmen and sold them on the value and beauty of the plant material they would have to disturb. He succeeded so well that there has been very little destruction and the restoration has proceeded in a very satisfactory and amicable fashion.

When the construction (or destruction) actually entered the Arboretum gates, at the end of June 1960, Mr. Tonkin practically slept on the bulldozers. Even when he did go to bed in the Gate House he and Mrs. Tonkin occupy on Hillcrest Avenue, I am sure he kept an eye open and ear acock for the slightest movement of man or machine. He was constantly everywhere, watching over each limb and twig. All with a smile and pleasant word, no matter how weary he was. Through heat, rain, mud, Donnas and unexpected situations, Mr. Tonkin and the City workmen have cooperated and remained on the best of terms. A triumph for both sides and a happy situation for the Arboretum. It was not always an easy matter; John Tonkin has many other responsibilities besides constantly curbing bulldozers. He is the Superintendent of the entire Arboretum, has a daughter, Mrs. Lewis A. Medlar who lives in Oreland, and two grandchildren.

John Tonkin was a vestryman of St. Thomas's Episcopal Church for 15 years and is intensely interested in the care and cultivation of their grounds. He is also a member of the Germantown Horticultural Society and the National Association of Gardeners. Mr. Tonkin's interests are not all local, he has given a great deal of his time and effort to establishing the International Peace Garden in Montana.

We of the Arboretum are indeed thankful to have such a dedicated, able, and courteous man in charge of our beloved place. May he be with us for many years to come.

Marion W. Rivinus

Performance of Five Selected Black Locust Clones at the Morris Arboretum

Frank S. Santamour, Jr.[1]

The wood of the black locust (*Robinia Pseudoacacia* L.) has long been prized for special uses. Some of these uses, as well as an account of the early cultivation of this species, have recently been discussed in the Morris Arboretum Bulletin by Li (1959). Although of local importance for some time, it was not until the late 1930's that national attention was focused on black locust. At this time the Soil Conservation Service of the U. S. Department of Agriculture undertook large-scale studies on the use of this species in erosion control. In 1950, the Morris Arboretum acquired material of five of their selected clones, including the Shipmast locust, for test planting on the Farm area. As a background to the discussion of the performance of these trees, it would be appropriate to examine some of the reasons for increased interest in this species.

Variation in Black Locust

Perhaps the greatest impetus to the intensive study of black locust was the recognition of a particular type of straight, fast-growing, and decay-resistant locust on Long Island, N. Y. Hopp (1941 a) described three major form-types as (1) Pinnate — with a well-defined stem and major branches on the lower portion of the crown, (2) Spreading — with a well-defined stem and major branches in the upper part of the crown, and (3) Palmate — with no easily traced main stem. He advocated the use of the pinnate type, such as the superior trees on Long Island, for farm planting.

An early report of variation in black locust on Long Island had been made by Hicks (1883). He referred to the "white" locust as being of the poorly-formed type usually found throughout its range and the "yellow" locust as a type with an exceptionally straight trunk and other desirable qualities. Long Island is outside the natural range of black locust and, therefore, both types of locust must have been introduced. The best evidence regarding the introduction of the "yellow" type, as summarized by Detwiler (1937) is that it was brought to Long Island from the lower Chesapeake Bay region of Virginia by a Capt. John Sands about the year 1700. However, extensive searches made in this area subsequently have failed to locate the original source.

The Shipmast Locust

According to Detwiler (1937) the name "shipmast" to denote this superior or "yellow" form was suggested by Dr. Charles F. Swingle in 1934 because of its tall, straight trunk. Raber (1936) used this common name when he described the select type as *R. Pseudoacacia* var. *rectissima*. Raber (1936) and Hopp (1941 b) have discussed the characteristics of form, bark, flowers, leaflets, and stipular spines which distinguish the Shipmast locust from the common type. In addition, they point out that almost complete sterility is characteristic of the Shipmast locust.

The high degree of sterility led to the early widespread practice of propagating these superior trees on Long Island by the digging and replanting of root sprouts. Swingle (1937) found that black locust was easily propagated from root cuttings and this method was used in the work of the Soil Conservation Service. The result of such early and extensive clonal propagation would normally result in the wide distribution of a single genotype. Hopp (1941 b) believed that probably all the Shipmast locust on Long Island, with the exception of one stand, were of a single clone. He also stated that many individual trees throughout the Northeast have Shipmast characteristics and Cope (1938) reported locust of the Shipmast type as quite common in the Hudson Valley. Thus, present evidence would suggest that the type of locust now cultivated as Shipmast is probably a mixture of several clones. As such, its designation as a botanical variety is not correct and the type should be called a cultivar and designated as *R. Pseudoacacia* 'Rectissima', as in Li (1959), or *R. Pseudoacacia* 'Shipmast'.

Insect and Disease Resistance

One of the major impediments to successful black locust culture is the locust borer (*Megacyllene robiniae*). The mining activities of the larvae in the heartwood cause extensive damage and the trees frequently break off at a point of serious injury. Hall (1937) compared borer damage to Shipmast locust on Long Island and common locust in Ohio by means of actual counts of emergence holes. The Shipmast locust

[1] Dr. Santamour is a geneticist on the staff of the Northeastern Forest Experiment Station, U. S. Forest Service. He is stationed at the Morris Arboretum of the University of Pennsylvania, where the Experiment Station and the Arboretum cooperate in genetics research.

appeared to be more resistant, although the climatic conditions of the two sites were different and the possibility of racial differences in the borer populations was not considered. In general, trees of high vigor are least attacked by the borer. Hall also pointed out that the greater *apparent* borer damage to common locust may be due to the fact that crooked trees are more susceptible to wind breakage after attack than the straight-trunked Shipmast. Berry (1945) reported, on the basis of relatively few trees, that Shipmast locust was attacked as readily as common locust in North Carolina plantings. Wollerman[1] stated that borer injury was greater on Shipmast locust than on other selected clones in Ohio and Maryland plantations.

Hirt (1938) found evidence that confirmed the old idea that posts of Shipmast locust were more durable in service. The wood of Shipmast locust was much more resistant than common locust to decay by four decay fungi under controlled conditions. However, only one tree of each type was tested. Grant *et al* (1942) stated that systemic brooming, a virus disease, had not been found naturally on Shipmast locust but had been transmitted to it by grafting.

Table 1. — Source data on the black locust clones under test at the Morris Arboretum

S.C.S. Number	Morris Arboretum No.	Locality of Origin
H.C. 4022	50-307	Glen Cove, Long Island, N. Y.
H.C. 4138	50-308	Blackwood, Va.
H.C. 4146	50-309	Barton, W. Va.
H.C. 4148	50-310	Barton, W. Va.
H.C. 4149	50-311	Townsend's Draught, W. Va.

The Arboretum Planting

Data on the origins of the five selected clones received in 1950 from the Soil Conservation Service Nursery at Beltsville, Maryland, are given in Table 1. Clone H. C. 4022 is the Shipmast locust and the other clones are described as having pinnate growth form. All trees were 1-year-old from root cuttings when received.

The trees were set out in non-contiguous square plots of 25 trees (5 x 5) and the spacing between trees and rows was 8 feet. The maximum distance between neighboring plots is 70 feet and the total area of Block I (near the corner of Northwestern and Stenton Avenues) amounts to about one-fourth of an acre. Sufficient trees of H. C. 4022 and H. C. 4148 were received to plant these clones in Block II. This area is near the northern boundary of the Arboretum on Stenton Avenue and about 0.2 miles from Block I. The soil throughout the planting area is circumneutral and is an excellent site for black locust.

Fig. 50 Shipmast Locust (clone H. C. 4022)

Measurements and Results

Various measurements were made on these trees in the fall of 1960. Diameter at breast height (4.5 feet above the ground) was measured with a steel diameter tape to the nearest tenth of an inch. On trees forked below 4.5 feet, only the largest stem was measured. Height measurements to the nearest half-foot were made with the "Spiegel-Relaskop". The number of locust borer emergence holes were counted on the lower 4.5 feet of the trunk. These data are presented in Table 2.

Most of the mortality appeared early in the life of the plantation and may have been caused by the poor condition of the stock. Since borers seldom attack smooth-barked young trees, they were not the major factor. Only six trees, now dead and standing, in the entire planting probably owe their demise, in part, to the locust borer.

Data on height and diameter were subjected to statistical analysis by the "t" test. There were no statistically significant differences in either height or diameter of clones H. C. 4022 or H. C. 4148 in the two blocks. For this reason and the fact that the remaining three clones are not now represented in Block II, comparisons between clones were made only on the growth in Block I. The Shipmast locust (H. C. 4022) was the poorest in growth rate, and the differences between this clone and all the others were highly significant. Wollerman (1956) also reported that clone H. C. 4022 was among the poorest in

[1] In the discussion following Wollerman (1956). Proc. Third Northeastern Forest Tree Improvement Conference, 1955, p. 37.

Table 2.—Characteristics of 5 black locust clones at 12 years from root cuttings

Clone	Block I					Block II				
	No. trees living	Ave. height	Ave. diameter	No. trees attacked by borer	Ave. no. borer holes per tree	No. trees living	Ave. height	Ave. diameter	No. trees attacked by borer	Ave. no. borer holes per tree
H.C.4022	24	24.9	3.7	11	8	11	24.1	4.2	7	3
H.C.4138	24	31.8	4.4	7	3	..	....	...	.	.
H.C.4146	20	33.1	5.5	3	6	..	....	...	.	.
H.C.4148	15	31.0	5.1	1	18	21	33.9	5.4	3	3
H.C.4149	12	36.9	5.9	1	3	.	....	...	.	

growth rate of the 10 clones he studied in Ohio and Maryland. Shipmast locust was about equal to the best local source in Southern Illinois (Minckler, 1948). Clone H. C. 4149 was significantly taller than all the other clones. The diameters of clones H. C. 4149 and H. C. 4146 compared to that of H. C. 4138 showed highly significant differences.

The Shipmast locust also appeared to be more susceptible to damage by the locust borer, both with regard to the number of trees attacked and the severity of the infestation. Several trees of this clone are just barely alive. One tree of clone H. C. 4148 in Block I has been heavily attacked but the tree had lost its top about four years ago and may have been rendered more susceptible.

Tree form and habit are characteristics that are difficult to evaluate, especially on young trees. On the basis of visual examination and comparisons of trunk straightness, the Shipmast locust must be regarded as inferior to the other clones. Observations made on the nine trees of each plot that do not occur in a border row also indicate that Shipmast locust does not prune itself well and live branches persist for a long time on the lower portion of the bole. Some idea of the difference in form may be obtained from a comparison of Figures 50 and 51.

Fig. 51 Clone H. C. 4138

Discussion

In the black locust clonal test at the Morris Arboretum, the Shipmast locust (H.C. 4022) has not lived up to expectations but it is not hard to understand why this tree had been judged superior at one time. In the first place, early comparisons were made between this cultivar and run-of-the-woods black locust which is generally a poor-quality tree. In a natural stand it may sometimes be difficult to see the individual good trees because of the forest of poor trees. Fortunately, this task is not impossible. The selection of superior phenotypes from natural stands today forms one of the major foundations of forest-tree improvement work. The four other locust clones in the Arboretum planting, as well as numerous others selected by the Soil Conservation Service, are a demonstration of the fact that better trees are available, can be found, and can be put to use to increase the quantity and quality of America's timber supply.

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Arboretum Activities

(Continued from Page 58)

Miss Milton has recently returned from a nine weeks' trip to Europe and the Middle East. She visited many of the important gardens of England, Holland, France and Italy and spent several weeks in Turkey and Israel. As a result of the numerous fine contacts made by Miss Milton, publications, plants and seeds will be acquired by the Arboretum. This is especially true of Turkey from which during recent years we have had little or no material.

Open House

For the first time since its inception several years ago our annual Open House was held in the autumn instead of the Spring. Sunday, October 16 was the date and some 300 associates and their friends visited the Arboretum, partook of refreshments and wandered about the grounds enjoying an unusually fine display of fall color.

This year, in place of a series of guided trips, we arranged a tour for our visitors to follow at their own pace. A trail, clearly designated by arrows and signs took in such features as the Studio, (where two courses for our associates were given this autumn), Oak Row (with its fine collection of ivies), the Ericaceae planting (a recently established concentration of members of the Heath Family), the Franklin Tree (on which a few belated flowers were still to be seen), the Medicinal Garden (in its new and permanent location), and the ever-popular Rose Garden. At each station a member of the staff was in attendance to welcome visitors and answer questions. This procedure elicited such favorable comment from our visitors that we shall doubtless repeat it on future occasions.

Contributor's Fund

Several years ago there was established a Contributor's Fund to be used at the discretion of the Director. Donations are, of course, tax exempt and anyone who contributes to this Fund will have the satisfaction of knowing that his gift will help to make possible some special project which could not otherwise be accomplished.

Fall Planting

Reference has frequently been made in these notes to the fact that autumn is our busiest season for moving plants from our nurseries to their permanent positions on the grounds. Favored by ideal weather throughout November and early December, this fall has been an unusually active one and nearly 200 specimens have been transplanted. About half this number were taken out of the greenhouse nursery, which will now be completely renovated.

One of our main projects has been to increase the representation in our Pinetum which occupies the hilltop between the Gates Building and the Morris Mansion. Among the pines which have been placed in that area this autumn are *Pinus apacheca, P. arizonica, P. Armandi, P. Jeffreyi* and *P. leiophylla* var. *chihuahuana.*

Considerable progress has also been made in adding to the family groupings on the area north of Northwestern Avenue.

Cost of Bulletin

Despite increased costs in printing and mailing, we have heretofore steadfastly resisted the temptation to raise the cost of this publication. The time has finally arrived, however, when we can no longer be so unrealistic. Beginning with Volume 12 for 1961 individual copies of the Bulletin will cost 40 cents (instead of 30 cents) and the price of a year's subscription will be raised from $1.00 to $1.50.

The Bulletin will, of course, continue to be sent free of charge to all of our Associates.

J.M.F., Jr.

Library Accessions

Among the items which have been added to the Library during 1960 are the following:

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Japanese Gardens for Today. D. H. Engel. C. E. Tuttle Co. Rutland, Vt. 1959

Landscaping with Vines. F. Howard. Macmillan Co. New York. 1959

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Woody Plants in Winter. E. L. Core & N. P. Ammons. Boxwood Press. Pittsburgh, Pa. 1958

New Associates

The Arboretum is happy to welcome the following new Associates who have enrolled since September 1960:

Mr. M. Worth Acker
Mr. Herman A. Affel
Dr. and Mrs. Harold R. Almond
Dr. William S. Armour
Mr. G. A. Arrington
Miss Dorothy G. Baldwin
Mrs. Mark E. Balis
Dr. Robert P. Barden
Dr. George D. Beck
Mr. B. Griffith Calder
Mrs. George Carleton, Jr.
Mr. Edward C. Clauson
Dr. Joseph K. Corson
Dr. and Mrs. Edward T. Crossan
Mrs. Philip Dechert
Mrs. George S. Fox
Mrs. Edward B. Isett
Dr. H. P. Kirber
Dr. and Mrs. W. C. Klingensmith
Mr. Merle M. Krider
Dr. Herman C. March
Dr. Edward H. McGehee
Mrs. Reed A. Morgan, Jr.
Mr. Horatio H. Morris
Mrs. Arthur E. Newbold, III
Outdoor Gardeners of Montgomery Co.
Mrs. Raymond T. Parrot
Mr. George E. Patton
Mrs. Corning Pearson
Mr. Eli Kirk Price, III
Mrs. Olga Raska
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Quercus palustris

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Arboretum Activities

The Staff

On December 3 the Director was the principal speaker at the annual dinner of the Philadelphia Chapter of the American Association of Landscape Architects which was held at the Benjamin Franklin Hotel in Philadelphia. On February 9 he gave an illustrated lecture on "A Botanist in India" to the High Twelve Club at the Union League.

Dr. Li participated in a Symposium on "Sciences in Communist China" at the 127th annual meeting of the American Association for the Advancement of Science held in New York on December 27. This Symposium was a joint program of the A.A.A.S. and the Conference on Scientific Communications, and was co-sponsored by the National Science Foundation and nine other scientific societies.

Winter of 1960-61

The winter through which we have just passed will doubtless go down in history as one of the most severe during the present century. A snowfall of well over four feet was the heaviest accumulation since 1898 and was accompanied by record-breaking low temperatures and long-sustained periods of sub-freezing days.

(*Continued on Page 12*)

Oak Wilt-A Serious Menace To Our Oaks

Charles L. Fergus[1]

A serious menace to one of our most important shade and forest trees is caused by a fungus, *Ceratocystis fagacearum*. It is oak wilt, a disease characterized by wilting and dropping of leaves and ultimate death of entire trees. No species of oak is immune; however, species in the white oak group (Lepidobalanus) react differently from species in the red oak group (Erythrobalanus).

The origin and history of oak wilt are somewhat obscure. Records and reports of dying oaks in the lake states lead us to believe that oak wilt has probably been present in Wisconsin for 25 years or more, but this cannot be established with certainty. In 1924, a competent forester described oaks dying in Wisconsin in a manner identical to that of oak wilt affected trees. In 1942, investigators at the University of Wisconsin proved that oak wilt was caused by a fungus.

Distribution

Until the summer of 1949, oak wilt was known only in parts of Wisconsin, Minnesota, Iowa, Illinois and Missouri. In 1949, it was found farther south in Missouri, at the northern edge of the Ozark region, and also in northwestern Indiana. It was the finding of oak wilt in southern Missouri that caused great alarm. Heretofore, the disease was known only in the more northern part of the oak range where adverse weather conditions and grass competition were believed to render oaks more susceptible to the disease. But in southern Missouri the climate is believed to be more conducive to oak growth.

In 1950, the disease was found in Pennsylvania, Ohio, Nebraska, Kansas and Arkansas, and in 1951, in Kentucky, Maryland, North Carolina, Tennessee, Virginia, West Virginia and Michigan.

The amount of oak wilt in the different states varies considerably. The central states have sustained greater losses and many more trees are diseased than in the other states.

Oaks and Oak Wilt in Pennsylvania

During September 1950, oak wilt was found for the first time in Pennsylvania in one location in the center of the state. Since oaks are economically the most important trees in Pennsylvania, considerable alarm was evidenced. There are approximately 15 million acres of forested land in Pennsylvania. Although the exact proportion of oak in these stands is not known, some estimates are as high as 50 per cent. In 1945, lumber production in Pennsylvania amounted to 463 million board feet. Oak comprised 43 per cent of this amount and, at \$50.00 per thousand board feet, was valued at 10 million dollars. In addition, oaks supply wood for miscellaneous wood products such as paper pulpwood, chemical wood, fence posts, mine timbers and cooperage.

Oak is also an important ornamental and shade tree in Pennsylvania's parks and private gardens. The aesthetic value of such trees is difficult to compute. If the tree dies, removal is required and to the aesthetic loss is added the cost of removal. The contract for removal of dead trees from Syracuse, New York, called for an average of \$110.00 per tree. The estimated cost of replacing an oak 6-8″ in diameter is \$200-\$300, and a 10″ oak, about \$400. In addition to being expensive, replacement of oak is difficult and many times unsatisfactory because such large oaks do not transplant readily.

The death of large stands of oak trees would reduce the effectiveness of our watersheds, and create the possibility of soil erosion and flash floods. In addition, acorns are an important source of food for our wild animals. Oak is indeed an important tree species.

As of the fall of 1960, aerial surveys and reports by various state agents as well as the public, have shown that oak wilt is in 25 Pennsylvania counties at 3525 different locations. Of these, 966 are single trees that were wilting at the time of their discovery, and were at least 100 feet away from any known wilt tree. In other areas from two to 70 affected trees were found. Measures have been taken to eradicate oak wilt in all of these known infected trees. No oak wilt has been found east of the Susquehanna River and 90% of the oak wilt in Pennsylvania is concentrated in Bedford, Fulton, Franklin and Huntingdon Counties in southcentral Pennsylvania adjacent to the Maryland border.

[1] Dr. Fergus is Professor of Botany and Plant Pathology at The Pennsylvania State University.

Fig. 1. Early stage of disease development on pin oak.

Symptoms

Oak wilt develops more rapidly in red, black, scarlet and pin oaks than in white oaks. The leaves in the top of the tree are the first to show evidences of the disease, becoming dull or pale green, and then brown. Affected leaves may fall at any time after symptoms appear, and infected trees are easily detected in early stages of disease development by the bare top branches and the browning of the leaves on the lower branches. Figure 1 illustrates this stage of disease development. The entire leaf blade does not need to be dead before a leaf will drop off. The symptoms progressively appear in the lower parts of the tree until the entire tree is dead. Green, leafy sprouts may form on the trunk and branches, but these soon die. A brown or black discoloration usually develops in the outer layers of wood below the bark. Most affected trees die one month following the first recognized symptoms. A few have survived to put out some leaves the next spring, but these soon wilt and die. The stumps and roots are also killed, thus preventing the normal regeneration by sprouting.

On white oak the affected leaves tend to remain rather than to fall, and individual branches are affected rather than the entire top of the tree as in red oak. One large branch may die one year, another the following year, resulting in dieback or a staghead appearance. Ultimately the entire tree dies.

Foliage symptoms may appear any time from May to September, following soon after infection. They are most conspicuous from mid-June to mid-September. Injuries caused by various other pests may be confused with oak wilt. Anthracnose, a disease that is especially severe on white oaks, kills the leaf area around the veins. Anthracnose is usually most severe on branches in the lower part of the tree, while oak wilt is at first most severe in the tree top. Frost and lightning injury, and dieback caused by various fungi, may also be confused with oak wilt. But in these troubles, abscission of leaves that have some living tissue does not occur as it does in oak wilt.

Another sign that an oak has wilt is the large mat of fungus hyphae produced on the outer surface of the sapwood and the inner surface of the bark. A mycelial mat consists of a central, thick, furrowed black pad surrounded by a whitish, grayish, or tan, cottony mycelium (Fig. 2). The thick pad is a pressure cushion, which by its continued thickening, cracks open the bark. The cottony mycelium surrounding the pad produces billions of conidia, asexual spores, and may produce black perithecia which extrude stickly ascospores as a white paste (Fig. 3). A single tree may have more than a hundred mats. The mats with their abundant conidia and ascospores play an important role in overland spread.

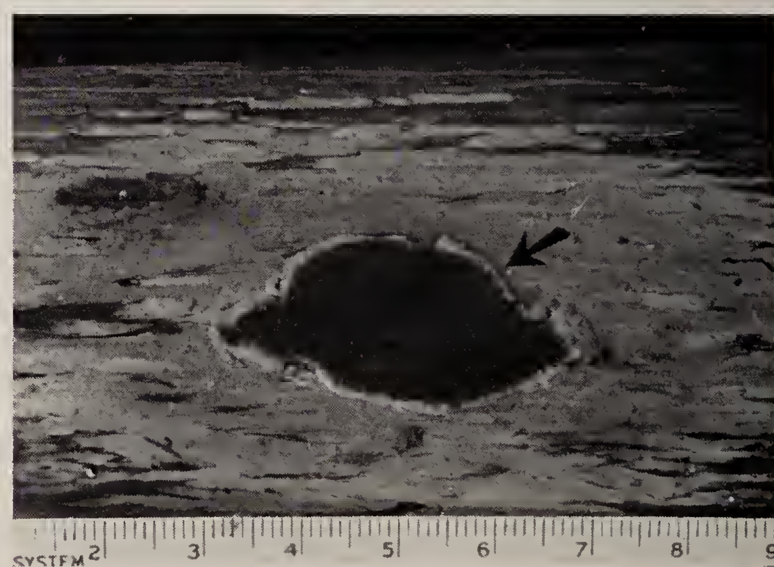

Fig. 2. A mycelial mat of the oak wilt fungus. The arrow indicates the central pressure pad. (x 2½)

Fig. 3. A mycelial mat upon which have formed many perithecia which exude ascospores as white, shiny, globose, sticky masses. (x 5)

What actually produces death in a tree infected with the fungus is still not completely clear. The mycelium of the fungus develops sparsely in the xylem in the initial stages of the disease. Apparently the fungus produces toxins, enzymes and hormones as products of its metabolism. It is these metabolic fungous products which affect the physiology of the tree.

It is known that tyloses, protoplasmic extrusions from xylem parenchyma cells into vessels through wall pits, form in considerable numbers in diseased trees (Fig. 4 and 5). These tyloses obstruct and slow down water movement through the trunk and branches so that the leaves wilt from a lack of water which is conducted mostly in the vessels of the xylem.

Dissemination of the Fungus and Control of the Disease

The fungus causing oak wilt is spread by at least two different methods. One method is by the pulling or sucking over of spores from the xylem of an infected tree into the xylem of a healthy tree through root grafts. This has been called local spread and is believed to occur for distances of 50 feet or less. When the roots of adjacent trees touch each other they gradually graft or grow together until a complete union is formed (Fig. 6). The extent of such natural grafts was demonstrated in Wisconsin by using fire engine hoses to flush the soil away from the tangle of roots of an oak grove. Twenty-eight grafts among three trees were found. In Pennsylvania, colored dyes have been used to trace root grafts.

Further spread of the fungus through root grafts may be prevented by breaking the root grafts. With shade and ornamental trees, digging a trench around the diseased trees, severing connecting roots, is recommended. This prevention method is impractical in most forest stands. In the forest, the healthy trees surrounding the diseased trees should be cut down and a silvicide applied to the stump to prevent future sprouting.

Much more needs to be learned about overland dissemination whereby the disease may appear several miles away from the nearest infected tree. Spread of fungus through root grafts is not involved in such cases.

Insects that visit the mycelial mats and then visit wounds on healthy trees are suspected agents of overland spread of the oak wilt fungus. There is a large number of such insects and they must be controlled to prevent overland spread. Eradication of diseased trees will help to suppress oak wilt by destroying the only known potential source of the mycelial mats (which produce the conidia and ascospores). Under certain conditions, it is feasible to saw the diseased tree into firewood and, if stored in a manner to promote rapid drying, no mycelial mats will develop.

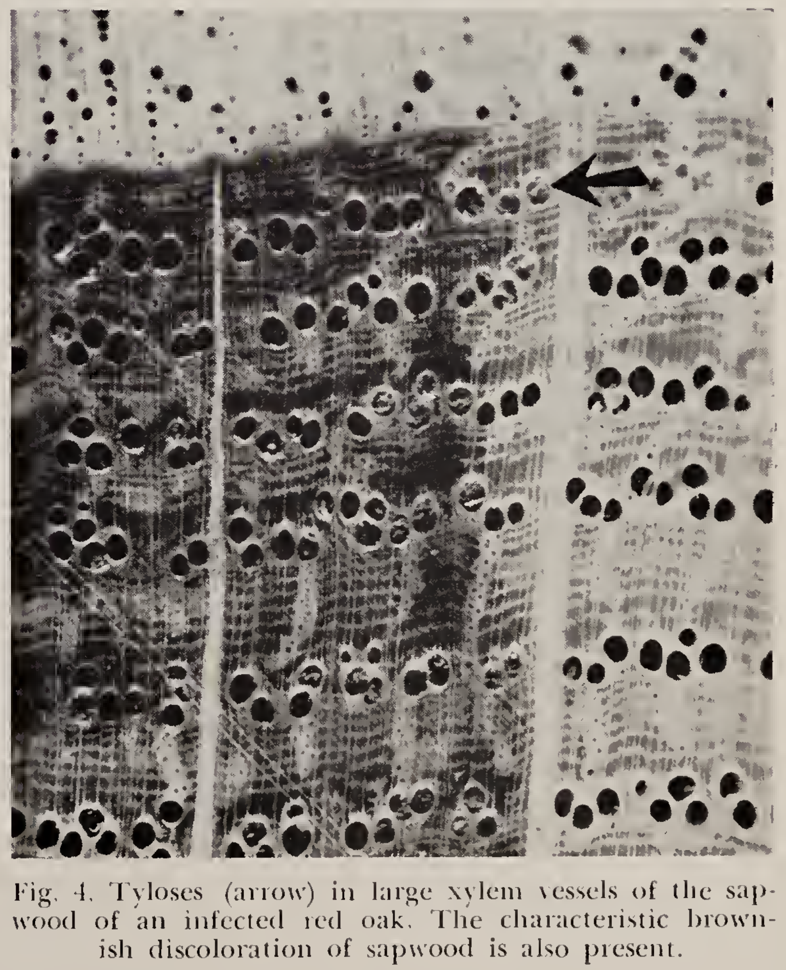

Fig. 4. Tyloses (arrow) in large xylem vessels of the sapwood of an infected red oak. The characteristic brownish discoloration of sapwood is also present.

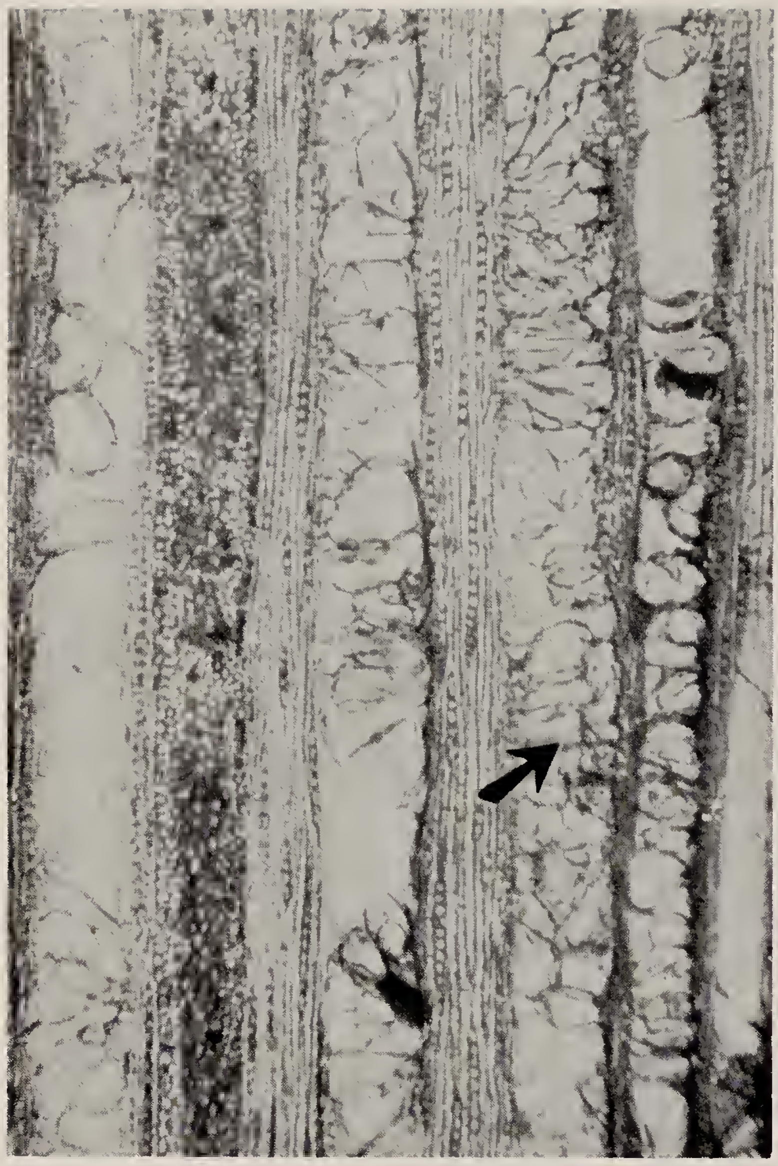

Fig. 5. Longitudinal section through a red oak twig collected three months after infection. Leaves had already wilted. Note the large numbers of compacted tyloses (arrow) formed in the vessels. (x 100)

The oak wilt fungus is very sensitive to a number of antibiotics and chemicals. The possibility of chemotherapy needs to be investigated. However, no sound recommendations for the use of chemicals can as yet be given. One difficulty that should be emphasized is recognizing symptoms early enough so that application of chemicals will be effective. Another difficulty results from the fact that if trees are treated indiscriminantly with chemical before they contract the disease, the wounding may result in infection.

With white oaks, the possibility of pruning out infected branches and thus restoring the tree to health is a good one. The problem will be to prune severely enough to get all infected branches.

Research on oak wilt has been in progress for a number of years at many universities and Forest Experiment Stations. There is reason to hope for continued progress in the future which will answer many questions that must be answered if successful control is to be accomplished.

Oak wilt is spreading slowly and there is no cause for hysteria concerning our oaks. On the other hand, there is no reason why great numbers of oaks will not ultimately be killed unless preventive action is taken. There is always the possibility that some factor of the environment, or the origin or introduction of a new more efficient insect carrier, may alter the present situation, allowing for a great increase and more rapid spread of the disease.

Under forest conditions such a sanitation measure is impractical; however, it has been found that "deep-girdling" the diseased tree will promote rapid drying out, thus preventing mat formation. The tree must be treated before all the foliage is wilted if this method is to be successful. "Deep-girdling" is performed by cutting a foot-wide band around the tree all the way to the heartwood. The tree is left standing since it will dry out faster than if it is felled.

Observations have shown that the most dangerous time of year for overland spread is April, May and June. Prevention of wounding of healthy trees in this period will protect the trees. Mycelial mat formation is most abundant, insects that spread the fungus are most active, and the trees seem to be most susceptible to infection during these months. If trees are wounded, proper care of the wounds, including application of a tree wound dressing, should prevent infection.

Fig. 6. Root graft (arrow) between two red oaks. The stumps of the two trees are visible at the extreme right and left of the photograph.

Cultivar versus Variety

John M. Fogg, Jr.

Few things are more irritating to those who work with plants than to find that an old, established and familiar name has been changed in favor of a new and totally strange one. Those who are not professional botanists tend to attribute these changes to some diabolical urge on the part of taxonomists to confuse the uninitiated or to foist their own interpretations on their colleagues.

As a matter of fact, most name changes are the result of one of the two following causes: (1) the discovery of an earlier valid name for the plant in question, or (2) a revision of plant relationships based on new information. A single example of each of these may serve to illustrate these two sources of confusion.

The common American Beech was known for many years as *Fagus americana*, a name given to it in 1826 by Sweet in his Hortus Britannicus. However, in 1789 Aiton had referred to it as *F. ferruginea* and in 1787 Ehrhart had called it *F. grandifolia*. Ehrhart's name is therefore the earliest binomial to be applied to this species and is the one which should be maintained. Unfortunately it is not always possible to predict that an established name will not be replaced by a still older one, but if any degree of stability is to be achieved the principle of priority is the one least susceptible to personal interpretation.

The California Big Tree was for many years known as *Sequoia gigantea* Decaisne. As such it was assigned to the same genus as the Redwood, *Sequoia sempervirens* (Lambert) Endlicher. However, Bucholz, who made a careful study of the morphological and reproductive structures of this species, came to the conclusion that the Big Tree is as different from *Sequoia* as that genus is from *Taxodium*, the Swamp Cypress. He therefore proposed the genus *Sequoiadendron* for the Big Tree and today most botanists follow him in calling it *Sequoiadendron giganteum*. This is an example of a case in which an overwhelming body of botanical evidence requires the transfer of a species from one genus to another with the resulting abandonment of a familiar combination. It is to be hoped that the future will see a decreasing number of such substitutions.

Many years ago the botanists of the world convened for the purpose of formulating a code or set of rules which would bring about greater stability in the naming of plants. These rules which have come to be known as The International Code of Botanical Nomenclature have been revised from time to time in international convocations, the most recent having been at Montreal in 1959.

In this code the principle of priority, which was mentioned above, has been maintained as a basic dictum, although provision has been made for the preservation or conservation of certain familiar generic names even though these may be found to be antedated by older ones.

In general, the rules which apply to botanical names serve equally well for horticultural ones. Certain differences, however, exist and it is for this reason that a separate code has been formulated and adopted for cultivated plants. This was accomplished under the auspices of the International Commission for the Nomenclature of Cultivated Plants of the International Union of Biological Sciences. These rules, known as The International Code of Nomenclature for Cultivated Plants, have been under consideration for several years and were finally endorsed by the Fifteenth International Horticultural Congress held at Nice, France, in April, 1958.

One of the chief discrepancies existing between botanical and horticultural practice has been in the application of the term "variety." To the botanist a variety is a sub-specific entity or taxon which occurs in a natural state. Thus, *Fagus grandifolia* var. *caroliniana* is a more southerly form of the American Beech in which the leaves are darker, thicker and more rounded at the base than in the more widely distributed species which is now to be called *F. grandifolia* var. *grandifolia*. Or, again, *Ilex montana* var. *mollis* differs from the common Mountain Holly (*I. montana* var. *montana*) in having leaves which are softly pilose rather than glabrous on the lower surface. Both of these varieties may have been introduced into cultivation, but the point is that they may have been derived from native populations and are not a product of the horticulturist or plant breeder.

On the other hand, there have originated in cultivation countless thousand of "varieties" which are completely unknown in the wild state. Some of these are hybrids, either accidental or intentional, some are sports or mutants, still others are the product of the skillful breeder applying the principles of selection to a variable population.

One thinks at once of the multitudinous names which have been applied to such familiar groups as roses, lilacs, ivies, azaleas, maples, hollies, crab-apples, cherries and tree peonies, to mention only a few.

One of the most significant steps taken by the makers of the newly accepted Code for Cultivated Plants was the adoption of the term "cultivar" (a word derived from "cultivated variety") to denote any plant below the rank of species which has originated or is maintained in cultivation. This term may be abbreviated "cv."; the name or names which follow it should be capitalized, e.g. *Cornus florida* cv. White Cloud or *Magnolia stellata* cv. Royal Star. In common practice the symbol "cv." is omitted and the cultivar names are enclosed in single quotation marks. The above then become *Cornus florida* 'White Cloud' or *Magnolia stellata* 'Royal Star.' Moreover, since the Code specifically states that a cultivar name should be applied to only one species within a genus, it is possible in horticultural parlance to refer simply to *Magnolia* Royal Star, without causing any ambiguity. In technical literature, however, the complete citation should be used.

In an effort further to distinguish between botanical and horticultural varieties, the Code has made the following additional provisions:

1) All new cultivar names must be in some language other than Latin. For example 'Pygmy' should be used instead of 'Pygmaeus.' This rule applies to names published after January 1, 1959, and is not intended to invalidate earlier cultivar names which have the form of Latin adjectives and which in the future will be used only for botanical varieties or other subspecific taxa.

2) Any language may be used to describe a new cultivar, although it is recommended that a translation in English, French, German, Spanish or Russian be appended.

3) Valid publication of a new cultivar name is acomplished by official registration, or printing the name in a book, checklist, catalog, or periodical of good distribution.

Numerous other stipulations have been written into the Code, but the above points should serve to emphasize the distinction between a botanical and a cultivated variety.

The application of the term cultivar is a broad one; it may be applied to carefully bred selections which come true from seed, as is the case with many garden flowers; to vegetatively propagated clones, or to line-bred hybrids or plants which are produced by the crossing of selected parents. As the term gains a wider usage throughout the world there is good reason to expect that much of the confusion which has long existed in horticultural nomenclature will be eliminated.

New Associates

The Arboretum is happy to welcome the following new Associates who have enrolled since December 1960:

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Mrs. Alfred Bissell
Mrs. P. Schuyler Briggs
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Remarks on Horticultural Ecology[1]

Edgar T. Wherry

In the course of their evolution individual plant species, or their subdivisions, have developed a considerable range of environmental preferences and/or tolerances, which it is the purpose of this discussion to summarize. Plant roots absorb from the soil quantities of water in which various essential nutrients are dissolved. This water ascends through the plant body, and ultimately evaporates from the leaves, the nutrient substances being utilized by the cells along the way.

Soil textures range from sandy and porous to clayey and impervious. Since roots are made up of living cells, they need a supply of oxygen for respiration as well as a means of disposing of carbon dioxide and other waste products of metabolism. The more impervious the soil is, the more the movements of these substances are restricted. Loosening up of clayey soils may therefore be an important horticultural procedure.

The more clay there is in a soil, the more water will be held in it, and in extreme cases a soil may become "water-logged." Such soils are often colloquially termed "cold." Water having a higher specific heat than most ordinary solid substances, resists temperature change (we use it in our automobile radiators for this reason). Wet soils, then, remain cold in the Spring much longer than do adjacent porous ones. Moreover, the change of liquid water to water vapor absorbs large amounts of heat (we use porous-walled containers to keep drinking water cool in midsummer). In general, then, plants brought from more southern to more northern regions should be set out in drier, more porous soils than those in which they grew in their native haunts. If care is taken in this respect, plants will often thrive one or two zones farther north than indicated on the "hardiness-zone" charts of horticultural manuals.

Sour Soils

When a horticulturist says that a certain soil is "sour," he means that growth in it is abnormal, — the individual plants may be stunted, or yellowed, or at any rate not producing desired effects. The significance of the word sour here is analogous to its use in other connections, — a poor musician strikes a "sour" note, or one person shows his dislike of another by giving a "sour" look. If there is one thing that the hearers of this lecture remember, may it be this: A SOUR SOIL IS NOT AN ACID SOIL.

Since acids do indeed have what we term a sour taste, the confusion here is understandable; unfortunately, even some eminent ecologists have been misled by it. But from the chemical standpoint it is false: if one makes tests with acidity indicators, more often than not "sour" soils prove to be definitely alkaline.

The reason for the "sourness" of densely clayey and waterlogged soils is the difficulty which oxygen has to get in and waste products have to get out. The stunting and yellowing of plants is due then to inadequate root-respiration as well as to poisoning by poorly oxidized organic compounds. Stirring such a soil with a stick may even yield the "rotten-egg" odor of hydrogen sulfide.

To improve "sour" soils, then, it is meaningless to add lime or other alkalies, as these may merely make matters worse. Instead, gravel or sand or cinders or peat should be mixed in to favor aeration. (The green film which may develop on damp cinders is not, as often alleged, a sign that they are "acid," being an alga or a moss of circumneutral preference). Some "worm-farmers" make considerable money by selling earthworms for this purpose, but all normal soils already carry just as many of these as they can support, so adding more is an economic waste.

In landscape gardening occasion may arise for planting trees in waterlogged soil areas which it is impractical to ameliorate, so native species can sometimes be used. In this region, for example, three which thrive in such soils are: Pin Oak, *Quercus palustris* (cover); Sweet Gum, *Liquidambar Styraciflua* (Fig. 7); and some forms of Red Maple, *Acer rubrum*.

Acid Soils

Now that it has been made plain that sour soils are not acid soils, the ecologic importance of soil acidity calls for consideration. When plant debris accumulates on or in the soil, fungi

[1] Based on a lecture given to a class in the Department of Landscape Architecture at the University of Pennsylvania.

Fig. 7. *Liquidambar Styraciflua*

proceed to break it down, turning the cellulose and starch into organic acids (from complex humic to simple citric, lactic and oxalic). In our relatively moist climate, the bases such as calcium and potassium oxides liberated from the plant tissues at the same time are dissolved and carried deep into the soil. If the underlying rock (and the soil grains derived by its disintegration) is of an insoluble type, such as sandstone and granite, the acidity will build up to the limit of fungal growth, somewhere around 4 or 5 in the pH system (these numbers run backwards, so that 4 means 10 times the acidity as does 5). If on the other hand the rock is limestone or calcareous shale, it will neutralize acids as fast as they are formed, and pH values of 6 to 8 will result. This range is termed circumneutral, the slight alkalinity represented by the number 8 being about as high as likely to develop in our moist climate.

These reaction values can be determined by the use of indicators, that is, dyes which change their color in relation to the pH numbers. They can be purchased in horticultural supply houses, and the chief point in using them is to be sure that the least practicable amount of dye solution is mixed with the soil sample. It is also important to make the test on soil from close to the plant roots. This is because of the frequent development of a "soil acidity gradient," with rapid decrease downward. The upper horizon (A) may have the high acidity value pH 4.5, the middle (B) moderate pH 5.5, and the lower (C) pH 6.5, which is so low as to be classed as circumneutral. Failure to recognize this situation has led to considerable misunderstanding as to the soil reaction preferences of individual species. Lists of plants from this standpoint have been published in Bailey's Hortus (under "Soils") and elsewhere. The one outstanding acid-favoring group is the Heath Family (Ericaceae). Many species of Oaks are also acid-soil plants.[2]

Ecotypes

At this point a word should be added as to the theory of ecotypes. If a given species of plant has succeeded in expanding its range over any considerable variety of habitats, it is likely to have developed strains or races differing in soil preference or tolerance. The most striking case I have encountered in this region concerns White Oak, *Quercus alba* (Fig. 8). In the Pennsylvania uplands this is on the whole a plant of moderately acid and even circumneutral soils. In the New Jersey lowlands, however, an ecotype has developed which favors intensely acid soils, occupying not only pine-barren country but also the "Plains", where the acidity reaches the maximum values of this general region. Some of the differences of opinion as to the soil preference of individual species which have been aired in the literature from time to time are undoubtedly due to this phenomenon. "When is a species not a species," one might ask; the answer: when it has broken up into a series of ecotypes. This, alas, introduces some complications into the contacts of the landscape gardener and the nurseryman: in the case of wide-ranging species, it may be necessary to insist that the exact source of stock offered for sale be made a matter of record.

Another ecological factor of considerable importance in relation to plant growth is temperature. The treatment of this factor in most horticultural writings is considerably over-simplified. Thus on the "PLANTSORT" card there is a set of 5 holes for "hardiness' ranging from capable of withstanding 0° to "tender". There is no indication of the existence of the phenomenon of "thermophoby" that is, avoidance of heat.

[2] See "Soil Acidity Preferences of Woody Plants," E. T. Wherry. Morris Arboretum Bull. Vol. 8:19-20. 1957, and "Woody Plants Suitable for Circumneutral Soils", E. T. Wherry. Morris Arboretum Bull. Vol. 8:59, 1957.

So far as cold-resistance is concerned, the breaking up of species into ecotypes is even more striking than in reference to soil features. Many largely subtropical groups have developed ecotypes with considerable winter-hardiness, e.g., the so-called Mimosa-tree, *Albizzia julibrissin.* Rehder gives the species-type as hardy to Zone V, hence to Virginia, but a cultivar *rosea* to Zone VII, hence to Massachusetts. Ecotypes of Crapemyrtle, *Lagerstroemia indica,* are now known which withstand zero weather in eastern Pennsylvania. It is not always the northernmost occurrence of a native species which is the most cold-resistant. Mrs. J. Norman Henry brought the southern Yaupon, *Ilex vomitoria,* to the Henry Foundation garden in Gladwyne, Pennsylvania, from its northern limit in Virginia, but it winter-killed. She then obtained it from considerably farther south in Oklahoma, and it has withstood

Fig. 8. *Quercus alba*

many severe winters since. The answer — the climate in Oklahoma is continental, with frequent sudden drops in temperature of 30° or more in a single night, so the ecotypes of such plants which have developed there can withstand anything they get in eastern Pennyslvania, at least as planted in porous acid soil half-way down a south-facing slope. This brings up the point about air drainage: since cold air is relatively heavy, it tends to settle to the base of a slope, so plants which have been moved considerable distances northward should be set out well above the base.

Soil Color

Soil color is not often mentioned in connection with plant-temperature relationships, but it does have significance. The darker a soil is in hue, the more heat it absorbs from the sun's rays, and the warmer it becomes. When plants are moved from warmer to colder climates, they are more likely to survive winter's cold if the soil is mulched with fairly dark material. The paler a soil is the more of the sun's heat it reflects, so the cooler it remains. Accordingly, when northern or high altitude plants are moved into more southern gardens, they may well be mulched with white or, at any rate, pale-colored litter. Red Pine, *Pinus resinosa,* a highly ornamental species native to Canada and the far northern U. S., but ranging southward only in the higher mountains of West Virginia, has been recommended for widespread planting; but when moved to lowland Pennsylvania and set in dark brown humus soil, it does not thrive. Its shallower roots seem to be injured by the summer heat, and thereby weakened, it falls prey to fungous diseases. In studying the possibility of covering the unsightly coal-refuse dumps of the anthracite region with vegetation, Dr. J. R. Schramm found that in that very black soil the summer sun heated the upper soil layer far above the air temperature, resulting in girdling and death of all shrubs of northern origin. When, however, the surface was covered with a thin layer of white sand, the soil remained cool and the plants survived. Many years ago I was asked to investigate why various "alpines" failed to thrive in a sea-level garden on Long Island; their seeds germinated well, and the young plants looked fine, but when set out in the sunny dark gray gravel their roots were soon "cooked" and the plants died. The damage was much less when the plants were set in a so-called "moraine" or "screen". This consists of thick layers of gravel, with water led in at the bottom; this water rises by capillarity, and evaporates at the surface, keeping the temperature down. The plants do not need water as such, but the cooling effect which is can produce.

The Water Factor

The last remark brings up the question of water requirement as an ecologic factor. Even the most gifted horticulturist does not expect to grow water-lilies on sand hills; but except for such obligate hygrophytes, few plants which grow in seemingly wet places really require so much moisture. Far more often, they can tolerate it, whereas their competitors can not. Take the Pine Barren plant, Southern or Atlantic White-cedar, *Chamaecyparis thyoides.* This oc-

cupies the wettest boggy stream banks, with Pitch-pine, *Pinus rigida*, approaching it but unable actually to compete with it. If this cedar is transplanted to dry soil, which in turn is definitely acid in reaction, without competitors it will grow quite satisfactorily and form striking evergreen columns. It does not turn rusty in the winter, as does northern White Cedar, *Thuja occidentalis*, and does not lose the foliage of its lower branches, as does Red Cedar, *Juniperus virginiana*. (In many gardens, to be sure, the latter two have to be used because they tolerate circumneutral soil.) Various Ericaceae and members of other families which grow in sphagnum bogs can also be moved successfully to drier situations with that one prerequisite that the acidity is high. In conclusion, may I repeat my earlier admonition in another form: A sour soil is NOT the place to set out any of these acid-tolerant or acid-preferring plants.

Arboretum Activities

(*Continued from Page 2*)

The impact of all this upon the plants in the Arboretum is difficult fully to assess at this time. Worst affected appear to be the pines, the cedars, and certain of the broad-leaved evergreens such as *Prunus Laurocerasus*, *Ligustrum lucidum*, *Pieris japonica* and *Osmanthus ilicifolius*. The foliage of these and several other species is so badly burnt as to cause grave doubts concerning its eventual recovery.

On the other hand, most of our *Ilex*, *Buxus* and evergreen species of *Rhododendron* seem to have come through in a rather satisfactory manner.

In the next issue of the Bulletin we shall attempt to analyze more realistically the results of this extra-ordinarily trying experience.

Spring Courses

The special short courses offered last Autumn proved so popular that they are currently being repeated with some modifications.

Beginning Thursday, March 2, Dr. Edgar T. Wherry, Emeritus Professor of Botany of the University, presented a six-weeks course on Ferns and Fern Allies. The class which was limited to 20 students, profited by the experience of one of the countries leading authorities on this group of plants.

Mrs. Ruth McVaugh Allen, who gave the course on the Families of Flowering Plants during the Fall Term, offered a continuation of this subject to a group of advanced students starting on March 16.

Associates are invited to watch for the announcement of similar courses both in these pages and on our bulletin board.

Seed Exchange

Reference has occasionally been made in this department to the Arboretum's annual exchange of seeds with other institutions in this country and abroad. Usually the emphasis has been on the number of samples which we have received from sister botanical gardens and arboretums.

It now seems appropriate to call attention to our own role in this exchange. Early in December our 1960 Seed List, which contained 117 items, was mailed to 226 institutions, 48 domestic and 178 foreign.

According to Miss Elizabeth Orsatti, who is responsible not only for assembling our list but for filling orders, we have to date received requests for seeds from 96 institutions, 16 of them in this country and 80 abroad. The total number of species requested is 1097. It would appear, therefore, that the Arboretum is doing its fair share in the dissemination of plant materials throughout the world.

Plant Distribution

The dates which have been set for the annual distribution of plants to our Associates are Friday and Saturday, May 26 and 27. Prior to these dates members will receive individual announcements together with a list of the species which will be available.

J. M. F., Jr.

Morris Arboretum Bulletin

JUNE, 1961

VOL. 12 NUMBER 2

Magnolia grandiflora 'St. Mary'

Published by
The ASSOCIATES of
THE MORRIS ARBORETUM

THE MORRIS ARBORETUM OF THE UNIVERSITY OF PENNSYLVANIA

The Morris Arboretum Bulletin is published quarterly at Philadelphia, Pa., by the Associates of the Morris Arboretum, Chestnut Hill, Philadelphia 18. Subscription, $1.50 for four issues. Single copies, 40 cents. Free to Associates.

THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

On Thursday, March 23, the Director gave the Five O'Clock lecture at the Philadelphia Art Alliance. His topic was "Spring in Philadelphia" and his talk was illustrated principally with colored pictures taken in the Arboretum. On April 27 he spoke to the Philadelphia Botanical Club on "Magnolias".

Dr. Li participated in the One Hundred and Seventy-first meeting of the American Oriental Society held in Philadelphia, March 28-30. His paper was entitled "Chinese record of pre-Columbian transatlantic travel by Arabian ships, with notes on the dispersion of some cultivated plants." He spoke on the same topic at the annual meeting of the Society for Economic Botany which was held in Cambridge, Mass., on May 11.

On May 6, Dr. Allison spoke at the Hawk Mountain Bird Sanctuary on the subject "Stump Stalking" and on May 20 she appeared on the television program "Concept" where she discussed some of the problems of Plant Pathology.

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Variations in Magnolia Grandiflora

H. Harold Hume[1]

Magnolia grandiflora L. is a broad-leaved evergreen tree native in the United States from Florida north to eastern North Carolina and westward from Florida into Texas. In Florida it extends southward to a line drawn through and from the county of Manatee across Highlands County to the vicinity of Sebastian on the East Coast. Nowhere does it grow far inland from the Atlantic Ocean or the Gulf of Mexico.

It is a noteworthy tree, not likely, even by the uninitiated, to be mistaken for any other growing naturally within the same region. In its densely foliaged head, clothed with large, rigid leaves, lustrous on the upper surface, it is distinct. It reaches maximum growth on soils naturally fertile and provided with goodly supplies of moisture, but at the same time with good drainage. It may reach a height of nearly 100 feet with a trunk diameter to 3 feet or more but usually it is found at a height of 60 feet or so. Its bark is grayish in color, free from furrows, somewhat roughened. The heart wood of old or very old trees is very dark, almost black, glistening. Newer wood is creamy white. Its flowers are borne singly at the tips of the twigs, large waxy-white, sweet scented, last for two days, beginning along latitude 30° N. in May. They are cup-shaped on the first day of opening. On the second day the anthers are shed, and mixed with pollen, are held by the saucer-like circle of petals. The aggregate, cone-like fruits mature in September when the red-coated seeds are protruded and hang for a time by slender thread-like filaments.

It is to be expected that a tree with a distribution so extended north and south, east and west, will show variations. This is true for *M. grandiflora*. There are noteworthy differences. This is so true that it is not too much to say that all seedling specimens differ in certain particulars from one another. A considerable number, all chance seedlings, have been selected, named and propagated, mostly in Europe.

The outline of the tree head may be irregularly round, conical or columnar. Usually they are compactly branched but trees can be found with heads fairly open with more widely separated branches, resulting in trees of quite different appearance.

Leaves vary in shape, size and undersurfaces. The blades are always rigid, usually obovate in shape but they may be almost round and mostly 4 to 10 inches long. A few specimens are known with leaves more than 13 inches in length. Those with small leaves (4 to 6 inches) present very compact heads because the leaves are commonly spaced closely together. Coloring of the leaf undersurfaces varies on different trees. In botanical texts the undersurface is often described as being tomentose, the tomentum colored like iron rust. Yet there are specimens without any sign of tomentum and others with gray-green tomentum. It is probably not too much to say that there are more magnolias with leaves green-gray on undersurfaces than there are with rust-colored ones. Trees along highway A1A between St. Augustine and Ponte Vedra, Florida are noteworthy for their rusty leaves. Coloring is of some importance for, when the branches and leaves are tossed by the wind a different appearance is imparted to the tree. Usually the upper surfaces of the leaves are quite smooth but here and there have been found with undulated or waved leaves, particularly toward the margins, that make the tree a very different looking specimen. Two trees with variegated leaves have been found; one of them is now being propagated.

The following variations of *M. grandiflora* have recently been selected as worthy of description:

'Bronze Beauty'

Leaves elliptic, 6¼ inches (16 cm.) to 9¾ inches (24.5 cm.) long by 3 inches (7.5 cm.) to 4 inches (10 cm.) wide, apices short, blunt pointed, upper surface glossy, laterally convex, midrib and secondary veins depressed, undersurface dull green without tomentum, midrib and veins clearly defined, elevated, base tempered. Leaves as they emerge are well marked dark bronze, a color retained for two or three weeks, contrasting strongly with the dark glossy green of old leaves; tree columnar in part, conical above, well branched down to ground, height 20 feet (6 meters) estimated. Original tree on grounds of Horticultural Department, University of Florida, Gainesville, Florida.

[1] Dr. Hume was formerly Dean of the College of Agriculture and then Provost at the University of Florida, Gainesville, Florida.

Fig. 9. *Magnolia grandiflora* 'St. Mary'

'Ocean Wave'

Leaves elliptic, 5½ inches (14 cm.) to 6¼ inches (15.5 cm.) long by 2⅛ inches (5.5 cm.) to 2¾ inches (7 cm.) wide, upper surface dark green, glossy, undulate or waved particularly toward the margins, midrib well defined, quite slender in upper part, lateral veins fine, undersurface tomentose, brown, apices tapered, blunt with slight twist, bases usually oblique, petioles short. The waved leaves, all of nearly the same size give this magnolia a very distinct appearance. The original was an old tree on the campus of the University of Florida. It was cut down to make way for a building in which the Hume Library is located.

'St. Mary'

Leaves obovate or elliptic, 6¼ inches (16 cm.) to 10 inches (25.5 cm.) long by 2⅜ inches (6.0 cm.) to 4 inches (10 cm.) wide, lustrous above, tomentose beneath, medium rust colored, midrib and lateral veins depressed above, elevated beneath, clearly defined, base tapered to blunt attachment with petiole; tree conical in outline, well foliaged; flowers cupped, of medium size about 5 inches across on first day of opening. (Fig. 9) [2]

[2] Cover illustration and Fig. 9 courtesy of J. Horace McFarland, Co., Harrisburg, Pa.

'St. Mary' was purchased as a seedling, one season's growth, from Joseph Vestal & Son, Little Rock, Arkansas, by the Glen Saint Mary Nurseries about 1905 and planted at Glen Saint Mary, Florida, where it is still growing. It is now about 55 feet high (estimated) with a trunk diameter of 21 inches (measured) at 4½ feet from the ground. It was selected and propagation began by grafting on seedling *M. grandiflora* stocks about 1910. At first it was not named. W. B. Clarke & Co., San Jose, California, obtained two trees in 1939 and scions at a later date from Glen Saint Mary Nurseries, propagated and, in their catalog for 1940-41, named it St. Mary. They were the first to publish the name.

'Sunset'

Leaves elliptic, blades 4½ inches (11.5 cm.) to 8½ inches (21.5 cm.) long by 1⅞ inches (4.6 cm.) to 3¾ inches (9.5 cm.) wide; apices tapered blunt, bases tapered to petioles, upper surfaces variegated, splashed with light yellow, undersurfaces tomentose, yellowish green, midrib elevated, well defined, lateral veins fine, clearly marked, bases blunt. Original tree found as a small seedling in woods of Glen Saint Mary Nurseries, Glen Saint Mary, Florida, and transplanted to open ground — now (1961) about 8 feet high (estimated). Branchlets with over all green leaves sometimes develop.

International Registration of Plant Names

John M. Fogg, Jr.

The preceding issue of this Bulletin contained a discussion of the recently accepted distinction between botanical and horticultural varieties of plants and emphasized the advantages to be derived from the universal application of the term "cultivar" to the latter group.[1]

In the same article reference was made to the prodigious numbers of varietal names which have been bestowed upon our familiar garden plants, such as roses, lilacs, ivies, azaleas, maples, hollies. crab-apples, cherries, peonies and many more. The account also described briefly the provisions of the International Code of Nomenclature for Cultivated Plants which have recently been adopted for the express purpose of achieving a precise and stable set of principles for the naming of plants which are important in agriculture, forestry and horticulture.

It is obvious that the task of determining the correct cultivar names for many thousands of plants is one of great magnitude and that its completion will require the services of a considerable corps of specialists over a period of several years. The undertaking calls for a high degree of international coordination and the willingness on the part of the individual collaborator to devote many hours of intensive and painstaking research to his assignment.

Even before the proposals of the International Code of Nomenclature for Cultivated Plants were officially endorsed in 1958, it had become apparent that some machinery should be set up for the international registration of cultivar names. In this country the Committee on Nomenclature and Plant Name Registration of the American Association of Nurserymen published a pamphlet entitled, "How to name a New Plant." Herein it was stated, "The registration [of new plants] should be made with or through the national society devoted to the genus or group involved. For example, a rose should be registered with the American Rose Society, a peony with the American Peony Society. For genera not represented by any society, among woody plants, the registration should be made with the American Association of Nurserymen."

In July, 1956, there took place at Los Angeles a joint meeting between representatives of the American Association of Nurserymen and the American Association of Botanical Gardens and Arboretums.[2] At this conference it was agreed to submit the problem of testing and registering plants to the member organizations.

At a meeting of the A.A.B.G.A. held in Philadelphia in August 1957, it was proposed that that organization should accept the sponsorship of an agency to accomplish the registration of new woody plants.

In April, 1959, representatives of the two above-named organizations met with members of the American Horticultural Council in response to a request from the Arnold Arboretum of Harvard University that it be authorized to proceed with woody plant registration.

Subsequently the A.A.B.G.A. was designated by the American Horticultural Council to act as the National Registration Authority for cultivar names of these genera of ornamental woody plants not currently registered by any other society, i.e., *Camellia, Fuchsia, Hibiscus, Ilex, Rosa, Rhododendron.*

At its annual meeting held in Rochester, N. Y., in October, 1959, the A.A.B.G.A. adopted a resolution that the Arnold Arboretum be designated a National Registration Center for ornamental woody plants for a two-year period from the date of the meeting October 10, 1959.

In March, 1960, Dr. Donald Wyman, Horticulturist of the Arnold Arboretum and Chairman of the newly appointed A.A.B.G.A. Committee on Plant Registration sent a letter to potential registrars soliciting their cooperation in the preparation of international lists of names and inviting them to be the recipients of cultivar names proposed in the United States for registration purposes.

It is obvious that before any specialist can validate a newly proposed cultivar he must be able to check it against a list of all previously published names in a particular genus.

Recognizing the nature and magnitude of this undertaking, Dr. Wyman's letter of invitation sounded the following warning:

"Such an international list is essential before one can act officially as a Registrar, i.e., all the cultivars of the genus which have been used in the past and present must be listed.

"Making such a list means that you may have to go back in the literature to Philip Miller's Gardener's Dictionary (1752) and check through

[1] Cultivar versus Variety. John M. Fogg, Jr., Morris Arboretum Bulletin. Vol. 12:7-8. 1961.

[2] For an account of the History of the American Association of Botanical Gardens and Arboretums see Morris Arboretum Bulletin Vol. 11:64-66. 1960.

many publications such as Index Kewensis, The Kew Hand List, Rehder's Bibliography, Proceedings of the Royal Horticultural Society and various French, German, Dutch and American periodicals and publications, as well as the historic files of nursery catalogs now at such places as the Bailey Hortorium or the Massachusetts Horticultural Society and the Plant Buyer's Guide. It is also a responsibility to write around Europe in an attempt to locate other lists which may not turn up in the literature.

"A good example to follow would be the International Rhododendron Register compiled by H. R. Fletcher and published by the Royal Horticultural Society in 1958."

The response to Dr. Wyman's letter, which was published in the A.A.B.G.A. Newsletter for October, 1960, has been gratifying. To date lists have been published in Arnoldia for *Gleditsia, Cornus, Pieris* and *Forsythia*. Copies of these, in leaflet form, may be obtained at cost from the Arnold Arboretum, Jamaica Plain 30, Massachusetts.

Also in preparation at the Arnold Arboretum are the following genera: *Fagus, Ulmus, Fothergilla, Deutzia, Philadelphus, Chaenomeles, Exochorda, Malus, Potentilla, Prunus, Spiraea, Cytisus, Robinia, Acer, Tilia, Buxus, Elaeagnus, Euonymus, Ligustrum, Lonicera* and *Weigela*.

In addition, specialists in other institutions have accepted responsibility for the registration of the following groups:

Dr. L. C. Chadwick, Ohio State University.
Taxus.

Dr. Donald R. Egolf, National Arboretum.
Pyracantha, Lagerstroemia, Caryopteris, Vitex, Viburnum.

Dr. John M. Fogg, Jr., Morris Arboretum.
Magnolia.

Mr. Sylvester G. March, National Arboretum.
Clematis.

Dr. Elizabeth McClintock, California Academy of Arts & Sciences.
Hydrangea, Leptospermum.

Dr. Philip A. Munz, Rancho Santa Ana Botanical Garden.
Garrya, Dendromecon, Romneya, Fremontia, Ceanothus, Arctostaphylos.

Mr. George H. Spalding, Los Angeles State and County Arboretum.
Myrtaceae.

Dr. John C. Wister, Arthur H. Scott Arboretum.
Syringa.

Persons having information concerning new cultivars in these genera should send it to the above individuals and no cultivar should be accepted in commerce until properly registered.

It should be further noted that registration of a cultivar does not imply evaluation. Once it has been determined that a proposed cultivar name has not been previously used the plant will be automatically registered, subject only to those provisions which govern the proper form of the name.

New Associates

The Arboretum is happy to welcome the following new Associates who have enrolled since March, 1961:

Mrs. L. C. Bosler, Jr.,
Mrs. Lillian Smale Bradley
Mr. W. O. Bradley
Mr. and Mrs. Gordon H. Chambers
Mr. J. N. Childs
Mr. Leslie N. Foster
Mr. John S. Haug
Mr. W. Wilson Heinitsh
Mrs. Philip C. Pendleton
Mr. Arthur Poley
Mr. Lee M. Raden
Mrs. Helen M. Roback
Mrs. A. O. Schaefer
Mrs. Tatiana E. Zell

Magnolia Notes from Rochester

Bernard Harkness[1]

Validation as a cultivar name of 'Highland Park' has been requested by Dr. Fogg for a plant of perhaps minor interest to collectors of the *Magnolia Soulangiana* hybrids. It has received at least quasi-recognition in the Second Edition of Dr. John Wister's mimeographed Swarthmore Plant Notes (1942) where the number 2636 is added to it, this being the field number. The same plant is in the Arnold Arboretum where it bears the number 885. This is apparently the number assigned to a seedling here, whether by Mr. Slavin or by Mr. Dunbar, the records do not say.

Magnolia Soulangiana cv. 'Highland Park' has the typical multi-stemmed *Soulangiana* habit but it falls short in height by one-third in comparison with typical mature plants of other clones. Flowering is annual and profuse. Flowers are cup-shaped, the segments measuring 2½ x 2½ inches. An occasional branch is so heavily set with buds that petal size is reduced to 1½ x 1¼ inches. The darkest coloring of the outside of the flower segments is 10 P 6/9 (Nickerson Fan); mostly this coloring is strong at the base and dilute toward the tip, the interior of the flower is uniformly ivory-white. There is a pleasant fragrance to the flower. Flowering is with the earlier group of *Soulangiana* varieties.

[1] Mr. Harkness is Taxonomist, Division of Parks and Recreation, Rochester, New York.

Magnolia Slavinii Reduced to Synonymy

After *Magnolia Slavinii* was first described (Nat. Hort. Mag. 33:118. 1954) as a hybrid of *M. salicifolia* × *M. Soulangiana*, it was pointed out by Mr. J. E. Dandy of the British Museum (Natural History) that a chromosome count would accurately determine the validity of this assumed cross. Dr. John Einset of the Geneva (New York) State Agricultural Experiment Station made such studies of root tips of a rooted cutting, finding the plant to be a diploid ($2n = 38$). It seems best to reassign the cultivar 'Slavin's Snowy', to *Magnolia Proctoriana* Rehd., thereby considering the parent Anise-leaved Magnolia to have been fertilized by some member of the subgenus Buergaria.

Aboretum Activities

(Continued from Page 14)

Spruce Hybrids

The Arboretum has recently received, through the generosity of the Northeast Forest Experiment Station, a valuable collection of three-year old hybrid Spruces.

These young plants are the product of a series of control-pollinated crosses made from known parentages by members of the Experiment Station staff either here at the Arboretum or elsewhere in the Philadelphia area.

Eleven species of *Picea* are involved in the parentage of these hybrids and 67 different progenies are the result. Since, in most cases, we have received three specimens of each cross, there are now in our nursery some 200 individual examples of this interesting series of hybridizations. Another complete set of specimens is being tested under forest conditions in Maine. It is hoped that at some future time it will be possible to report here on the comparative behaviors of these two sets of hybrids.

Spring Planting

As was mentioned in our issue for December, 1960, fall planting was carried forward at a lively pace thanks to mild weather conditions which prevailed throughout October and November. Early in December, however, freezing temperatures set in and continued during the remainder of that month and, indeed, most of the succeeding months until Spring. The result was that fall planting came to a standstill with large numbers of plants still awaiting removal to their permanent sites. Although the advent of Spring was somewhat tardy, there was still time to resume our outplanting program during late April and early May. The result has been that we are about where we should have been last December and can at least face a new growing season with the feeling of not having fallen too far behind.

J. M. F., Jr.

Notes on Ornamental Horticulture in Western Turkey

Mary O. Milton

In the Autumn of 1960 I had the opportunity of traveling through the western tip of the Black Sea region, down the Aegean coast to Izmir, east on the Anatolian plateau to Isparta and Konya, and north past Turkey's Salt Lake to Ankara. This represents only the western third of Turkey, which is a large country and seems even more spacious because of its wide areas of treeless lands, its mountains and its tremendous coastline.

Turkey may be divided into five major geographical areas: the Black Sea region to the north, the Aegean Sea area on the western coast, the Mediterranean coast of Southern Turkey, the vast mountain and steppe lands in the east where Turkey borders Russia and Iran, and the Anatolian Plateau with altitudes which range from 1500 to 3000 feet. This geographic diversity produces widely dissimilar climates which in turn determine to a great extent the existence of ornamental horticulture. As temperature and rainfall vary so does the native vegetation as well as horticultural practice.

My primary interest was in seeing the methods of growing woody ornamental plants. I was most favorably impressed by the interest in horticulture, the variety of species grown, and the very cordial and gracious reception extended to me by people working in this field.

The Anatolian Plateau

While the climate along the Aegean coast is conducive to plant growth, ornamental horticulture in Ankara on the Anatolian Plateau must be coaxed and persuaded to exist at all. (Fig. 10) . Ankara lies at an altitude of 3000 feet and is hot and very dry in summer and cold with moderate snowfall in winter. The city itself has wide boulevards lined with young plantings of Chestnuts, Sophora, Flowering Cherry, and Oriental Plane trees. Most of Ankara appears to be a new city with many new apartment and office buildings. New streets and parks are landscaped as soon as construction is completed. The private gardens are rather uniformly planted with *Ligustrum*, *Kerria*, Lilac, Euonymus, Roses, and various species of apple, peach, cherry, and pear grown for their fruit. In addition there is usually a small vegetable garden. Annuals, perennials, and tulips which are native to Turkey, are used in almost every private garden.

The street and highway plantings are done with exacting care. The cultural procedures are similar to those used in the United States with the exception of the method and amount of watering. All lawns, flower beds, trees, and shrubs are watered throughout the summer and fall. Well established trees and shrubs must very often be supplied additional water.

The highway plantings are watered by tank truck. Dishes often 12 to 15 inches deep are dug around the newly planted trees to facilitate watering. Many trees are fenced in to prevent sheep, goats, and donkeys from eating the leaves and twigs, and since a great many sheep are driven to market by shepherds this fencing is often found quite close to the city.

Fig. 10. The Anatolian Plateau north of Ankara

The area around Ankara is kept treeless and nearly devoid of vegetation due to the lack of rainfall and the incessant grazing. It is difficult to realize that this plateau once supported dense forests. Actually, heavy forests were reported in the Ankara area until the end of the seventeenth century, at which time the exploitation of forests and increased numbers of sheep and goats, which now number many millions, reduced the land to its present condition.

Ataturk Orman Farms exist on some 25,000 acres just outside the city of Ankara. The Farms,

Fig. 11. *Pinus Sylvestris* at Ataturk Farms, Ankara

established by Kemal Ataturk in the 1920's, and now under the direction of the Ministry of Agriculture, include ornamental plant nurseries, vineyards, forests, parks, a zoo, dairies, pasturelands, wineries, a brewery, restaurants, and public recreational facilities. When one compares these accomplishments with the surrounding area the Farms stand as a monument to the dedication of people determined to succeed where nature works so diligently against them.

Many years have been spent in attempting to establish forests at the Farms. Thousands of pines (Fig. 11) now replace the Robinias found not to tolerate the Ankara soil and climate. The parks and gardens are pleasantly landscaped, and the swamp which Ataturk found in 1925 is now a series of walled streams, small gardens, and a large recreational lake.

Mr. Muammer Akalin, nursery and park superintendent, spent an afternoon showing me the nurseries and explaining the methods of maintenance. A great deal of nursery work is necessarily done by hand but modern equipment is available and utilized for plowing and major grading work. Seeding, planting, weeding, and cultivating are done by hand. Watering is accomplished by a series of irrigation ditches. I questioned the source of a white foamy deposit in the irrigation ditches and Mr. Akalin told me that while there were deep wells and pumps supplying thousands of gallons of water to the various areas of the Farms, the source of irrigation water for the ornamental nurseries was waste water from the nearby brewery. This is an indication of the intelligent utilization of water.

The ornamental nurseries consist of trees and shrubs of the hardier variety found growing in our mid-western states: Juniper, *Ligustrum*, *Lonicera*, Roses, and Cotoneaster. A large section of the nursery is given over to the growing of roses. This includes budding trellises for standard roses. The native Dog Rose (*Rosa Canina*) is used for understock. So far as I was able to determine, most roses are sold by color and habit of growth rather than by varietal name.

Mr. Akalin is attempting to establish ornamental stock plant nurseries for propagating material. At the present time many plants must be imported and the cost and importation regulations are prohibitive. Since Ataturk Farms qualify as an educational establishment the Morris Arboretum has offered to send seeds of ornamentals to be screened for hardiness in the Ankara climate in exchange for seeds of plants native to central Turkey.

Arrangements were made through an interpreter to visit the Horticultural Department of the University of Ankara. We were directed to the office of Doctor Sabintini Ozbek, Chairman of the Department of Economic Horticulture. Although there are few students of ornamental horticulture at the University and even those few have their major curricula in agriculture, Dr. Ozbek and his staff displayed an excellent knowledge of and a great deal of interest in ornamentals.

Dr. Ozbek spoke at length about the problems of plant importation, especially where fruits are concerned. At the present time Turkey does not have the great quantities of pesticides and the means of applying them which are available in the United States, and the introduction of disease can be disastrous to the many small growers in Turkey. He pointed out that he had seen peach and cherry varieties in the United States that he felt would do well in Turkey, but the risk of introducing diseases and insects difficult to control would negate the possible advantage in increased yields. In view of the im-

Fig. 12. Mr. Cemal Koygun, Assistant Director of the Bueykuekdera/Istanbul Research Station. *Magnolia grandiflora* in foreground.

Fig. 13. *Cedrus deodara aurea*

portation restrictions on economic plants a great deal of breeding for hardiness and to develop higher yields is carried on.

Dr. Ozbek arranged an appointment with Dr. Gunel Akdogan, Landscape Architect on the teaching staff of the University of Ankara. Dr. Akdogan spent a day showing me the parks and greenhouses in Ankara. Her knowledge of practical horticulture was surprising and in answer to my comments she explained that in Turkey all students of agriculture or its related fields are introduced to many phases of agriculture and must spend considerable time doing practical work in nurseries and on the farms of the various governmental research stations.

The plant material on the campus of the University is not unusual. A great deal of bedding of annuals, biennials and herbaceous perennials is practiced. The foundation plants are *Cotoneaster, Juniperus, Thuja, Euonymus* and some *Buxus.* The specimen or shade treets are Chestnut, Oriental Plane, Flowering Cherry, Ash, Sophora, and Italian Poplar. A botanical garden for the use of the students is being established on the campus. Native and exotic species will be landscaped into plant families.

The Aegean Area

Although the variety of plant species in the Ankara areas is necessarily limited by the adverse climate, Istanbul enjoys the moderating effects of the Black and Mediterranean Sea and a most impressive assortment of ornamentals is grown here. The Horticultural Research Station at Bueybuekdere/Istanbul produces a wide variety of plants and, as at Ataturk Farms, these plants, both of ornamental and economic value, are grown for sale to the public and for breeding and research work. Mr. Cemal Koygun, the Assistant Director, very kindly showed me around and explained the work which was in progress. (Fig. 12).

There are a great many plants native to America grown here: the Monterey Pine (*Pinus radiata*), Arizona Cypress (*Cupressus arizonica*), the ornamental silvery-blue pyramidal form (*C. arizonica glauca pyramidalis*), Koster's Blue Spruce (*Picea pungens Kosteriana*), Southern Magnolia (*Magnolia grandiflora*), Eastern Baccharis (*Baccharis halimifolia*), Variegated Box Elder (*Acer Negundo variegatum*), Osage Orange (*Maclura pomifera*), Dogwood (*Cornus florida*), and Redbud (*Cercis canadensis*). American varieties of apples, grown for studies of yield and hardiness and for breeding purposes. include Stark King, Stark Delicious, Golden Delicious, Rome Beauty, and Stayman Redsap.

In addition, there are pears with such exotic varietal names as 'Akca' and 'Mustabey'; peaches with such widely diverse names as 'Dixiered', 'Alberta Giant', 'Bonvicini' and 'Doctor Goekay'. Also growing here are English Walnut (*Juglans regia*), which is not English at all but a native of China; native apricot varieties, (*Prunus Armeniaca*), Almonds (*Prunus Amygdalus*), Pomegranates (*Punica granatum*), and the native Persimmon (*Diospyros Lotus*).

There are many, many plants often seen in our own gardens such as the Silktree (*Albizia julibrissin*), Weeping Willow (*Salix babylonica*), the oriental species of Sweet Gum (*Liquidambar orientalis*), Chinaberry Tree (*Melia Azedarach*), Ligustrums in variegated, weeping and standard forms; Weeping Ash, Elm, Sophora; Leatherleaf Viburnum (*Viburnum rhytidophyllum*), *V. Tinus,* Crêpe Myrtle (*Lagerstroemia indica*), magnificent Golden Atlas and Golden Deodar Cedars (*Cedrus atlantica aurea* and *C. deodara aurea*), rows of the daintily foliaged *Cotoneaster buxifolia;*

Fig. 14. Garden at Yalova

Fig. 15. Garden at Yalova

Jujube (*Zizyphus jujuba*), and Italian Cypress, (*Cupressus sempervirens*). (Fig. 13). The columnar form, (*C. sempervirens stricta*) is planted in many cities and towns in western Turkey. Also widely used are the very ancient Judas Tree (*Cercis Siliquastrum*), *Rhododendron ponticum* (native to the mountains of Turkey) the Loquat (*Eriobotrya japonica*) and *Raphiolepis ovata* which is perfectly hardy in Istanbul's climate.

There is an area south of Istanbul across the Bay of Izmit that is almost subtropical in climate. Yalova, one of the spas in western Turkey, has an outstanding garden. (Fig. 14). Here one finds meticulously kept borders, topiary, variegated forms of English Holly, *Ligustrum*, *Enonymus* and *Elaeagnus*, and a collection of plant material which includes such widely separated geographical species as Atlas Cedar, evergreen Magnolia, Bananas, and Palms, all of which blend to create an atmosphere of tropical profusion. The plants here are exceptional in the lush growth of the deep green foliage and contrasting vivid splashes of color. The gardens are undoubtedly benefited by the daily watering of the iron and sulfur mineral water, and affected, too, perhaps, by the warm underground springs. (Fig. 15).

South of Yalova near Bursa and Mount Uludag there are beautiful forests of oaks (*Quercus macrolepis*) used in the tanning industry, pines (*Pinus halepensis brutia*) and higher in the mountains, forests of the richly green Aleppo Pine (*P. nigra caramanica*).

Further east and south, through regions of olive groves, vineyards, tobacco and cotton fields, and stands of fig trees, is the beautifully clean subtropical city of Izmir. South and west of Izmir towards Isparta camel caravans laden with produce destined for the international markets of Izmir are a common sight. Dotted along the highways are abandoned camel caravan stations, now occupied by an occasional shepherd. North past Konya, where the delicious rose jelly is made, are miles and miles of wheat fields. Modern trucks and tractors are not an uncommon sight, but oxen and the simple hook-bladed plows in use two thousand years ago are more frequently seen.

Ornamental horticulture on Turkey's western coast is much as we see it along our own southeastern seaboard, with the exception, of course, of the different plant materials used. There are lovely private gardens, well established parks, and the streets and highways are nicely landscaped. Flower shops and flower vendors are a usual sight. On the Anatolian Plateau however, the use of woody ornamentals is restricted to governmental buildings and the private homes of the more affluent residents. We must keep in mind, however, that the cultural development of central Turkey began just a little over 30 years ago. Prior to that time Ankara was little more than a dusty village. If the progress in ornamental horticulture continues at its present rate, in a few years the young parks, the new street and highway plantings will mature and home landscaping will become more prevalent. But work, time, and indefatigable patience are needed to make nature yield to man. The Turkish people certainly possess the qualities necessary to continue this monumental task.

Associates' Corner

The Old Mill

Back in Colonial days numerous mills dotted the banks of the Wissahickon and its tributaries. Run by the power of the stream, they were of many kinds: grist, fulling, oil, saw, and paper mills.

Roads were few and far between in those days and frequently they were impassable in bad weather. Farmers were often forced to bring their produce to be ground on horse back. The mills were gathering places to hear the latest news or to barter and exchange goods with the miller or with their neighbors. The miller was a person of some importance in the community.

Many traditions and stories are associated with the old mills in the Wissahickon Valley. One of these tales concerns a miller named Livezey whose grist mill was situated at the foot of Allen's Lane. It is said that when the British were in Philadelphia Livezy sunk several barrels of home-made wine in his dam, fishing them up again for bottling after the war. One wonders what the wine would taste like today with a nice cap of heady detergent froth.

The old mill at the Arboretum is on the banks of the Wissahickon north of Northwestern Avenue. It was built by William Streeper, Jr. before 1761 as a grist and saw mill. The Streepers were among the oldest settlers in these parts. They took their name from a Willem Streypers who came to Germantown with Francis Daniel Pastorious and whose family was one of the fourteen original settlers.

The Arboretum mill is credited with supplying flour to Lafayette and his troops while they were encamped at Barren Hill. This is entirely possible, for the output of all the mills in the vicinity would have been requisitioned for both armies and it was a matter of which side got there first. Those were rough times for a miller.

When William Streepers, Jr., died in 1783 his widow sold the mill to one of his sons, George by name. In the meantime John Piper, who owned considerable property around Chestnut Hill, had married Hanna Streeper and they purchased our mill in 1789. It became known locally as the Piper Mill and the record states that

Fig. 16. The Old Mill

Piper rebuilt it and probably placed on it the date stone which reads "Springfield Mills 1854."

This could hardly have been the case as Henry Piper was the owner from 1846 and assuming that John was in his twenties when he bought the mill, by 1854 he would have been at least a spry 75. More power to him if he felt like rebuilding with an eye to the future so late in life. It seems more likely that the credit should go to Henry. At any rate, the original building is far older than the present date-stone reading 1854 would indicate.

Henry Piper owned and operated the mill until his death in 1881. After that the idle mill was included in the sale of the surrounding property as it passed through several hands, eventually being acquired by John T. Morris and left, together with the rest of his estate, to his sister Miss Lydia T. Morris, who in turn bequeathed it to the University of Pennsylvania.

The Morrises repaired the old mill and made of it a picturesque feature of their farm. Its grinding days are over, but in a freshet as the old wheel turns perhaps it is quietly singing of the scenes it has witnessed in by-gone days.

Marion W. Rivinus

Winter Injury

Patricia Allison

"Peter Kalm, visiting this country from Sweden, wrote under date of September 23, 1748:

'It is true that in Pennsylvania and even more so in the lands farther to the north, the winters are often as severe as in Sweden, and therefore much colder than in England and the southern countries of Europe. I found, for instance, that in Pennsylvania, which lies by 20 degrees farther south than some provinces of my fatherland, the thermometer of Celsius fell 24 degrees below freezing. And yet I was assured that the winters which I spent there were not of the coldest, but quite ordinary.' "[1]

Was last winter in the Philadelphia area one of the coldest or "quite ordinary?" For an answer, we can search weather records and we can also look about us for lingering evidence. In Pennsylvania, record lows far colder than 11 degrees below zero (24 degrees below freezing, Celsius) are commonplace — everywhere but in Philadelphia, that is. Here, the record minimum just equals Mr. Kalm's reading. The low of the winter past was minus four degrees. Suppose we look about us. At the Arboretum, a Deodar, *Cedrus Deodara*, 42 feet tall, 17.5 inches in diameter a foot above the ground, stands on the hill near Gates Hall. There is a wisp of green at the base, another at the top. It may never again be the splendid specimen it was. Not far from the swan pond, an Incense Cedar, *Libocedrus decurrens,* still is a 23 foot pillar of brown. These are plants that had survived many winters. Elsewhere, *Ligustrum lucidum, Prunus Laurocerasus, Davidia involucrata, Buxus* spp., *Magnolia grandiflora, Rhododendron* spp. (azaleas) *Chaenomeles* spp., *Callicarpa* spp., *Pyracantha crenulata, Chionanthus retusus, Osmanthus ilicifolia, Pinus Armandi, P. Taeda, P. arizonica,* and *P. Pinaster,* have been killed outright or are severely damaged. Was it an ordinary winter? It assuredly was not. So extraordinary was it, in fact, that even the pattern of daily weather at the airport station, where temperatures are often as much as ten degrees different from those in the suburbs, gives us a good picture of just how severe the hardiness test was at the Arboretum.

Before considering the record of Weather Bureau measuring instruments and the records provided by botanical instruments, it might be recalled that many of the commonly reported types of "winter kill" are not winter kill at all, but fall or spring kill. Woody plants are much like animals in certain respects. One of these is their ability to withstand certain rigors in their environments if the rigors are presented to them gradually. Mice, for example, are better able to withstand continuous cold if they have been subjected to short periods of lowered temperature prior to the prolonged exposure.

Fig. 17. Flower buds of *Magnolia Soulangiana amabilis.* Both began to swell, but the one on the right died.

A great many of the mechanisms underlying such preparedness are not yet understood, but the overt results in woody plants are often quite conspicuous. Twigs that, in spring, were delicately pliant, become during summer, increasingly woody. Twig epidermis, once green and tender as that of a young leaf, ensheaths itself in resilient, corky waterproofing. Buds remain sheltered in waterproof scales. The weather-conditioning seems to proceed with astonishing swiftness when deciduous plants lose most of their porous evaporative surfaces, the leaves, in autumn. Similar, though less conspicuous changes occur in evergreens. These profound physical changes come about only because of metabolic changes in the plant. Not all of such metabolic changes are as obvious to us: the lessening of respiratory rate, the slowing of water and mineral utilization, the invisible modifications in living substance that make it less sensitive to cold.

[1] Sauer, Carl O. 1941. The settlement of the humid east. p. 157-166. *In* Climate and Man. Yearbook of Agriculture, U. S. Government Printing Office, Washington, D. C.

There are limits imposed by heredity to the degree of winter preparedness that plants can achieve. This results in what we might term "species hardiness." But because the weather in late summer and autumn is not the same year after year, the success of a given plant in attaining its limit of preparedness, or species hardiness varies from year to year. "Fall winter kill" frequently follows a period of unusually warm, moist weather when winter preparedness is not yet complete. Buds may swell and even elongate into tender shoots. The perfectly normal autumn temperatures following such a period of growth kill the shoots and weaken the plant. No record low was set for the Weather Bureau archives, yet the plant was damaged. Such injury, especially if confined to buds, may become evident only at the beginning of the next growing season. Diagnosis: winter injury.

In the spring the same sort of injury can occur. A few unseasonably warm days inserted in the otherwise gradual transition between winter and spring are sufficient to make some plants relinquish their hold on their winter defenses prematurely. Subsequent normal spring frosts then damage tender tissues that had begun the long series of alterations that culminate in summer's verdure. Thus, the failure of buds to develop, and the desiccation of broad-leafed evergreen foliage are often attributed to "winter kill."

Fig. 18. Brown-needled *Pinus Armandi*.

Fig. 19. Winter injury to Boxwood.

This year, however, we have seen definite evidence of true winter damage, and no wonder. At least 12 low temperature records were equaled or broken. December was bad enough: the second coldest in 89 years, 11 days with maximums of 32°F or below, 29 days with minimums below freezing. A number of the damaged plants could have been injured then; we do not know for certain. We do know that symptoms were visible shortly after the "fatal fifteen" days of January and February. Beginning with January 19, nearly every conceivable plant-damaging feature of winter occurred.

There were 15 *consecutive* days with maximum atmospheric temperatures below freezing. The second lowest temperature ever recorded in Philadelphia by the Weather Bureau, minus 4, occurred twice in two weeks. (At the Arboretum, where temperatures were approximately 10 degrees below Weather Bureau measurements, the number of consecutive days of subfreezing weather probably was 21.) During the "fatal fifteen" plants were subjected not only to frigid temperatures, but to drying winds. During the fifteen days there were extended periods of brilliant sun when frozen needles, bark, and twigs could well have reached their thawing temperatures. During the fifteen critical nights, there were frequent starry skies into which the earth's poor warmth fled anew, plunging slender plant parts once again into the frozen state.

Symptoms of winter damage varied not only in severity, but in time of appearance. The leaves of the Deodar began to turn brown during the first week of February. With some Mag-

nolias, however, the flower buds seemed to swell normally when spring came. Only after many flowers had expanded was it realized that a large proportion of swollen buds had died, and that the injury extended down the twigs an inch or two (Fig. 17). Although there was extensive leaf, bud, and twig mortality among many trees and shrubs, adventitious buds have begun to develop. This is even occurring among some of the pines that were at first considered lost. Whether or not the trees will survive is still unknown. *Pinus Armandi,* among the most seriously damaged, probably will not (Fig. 18). Boxwood suffered extensive damage, but none of the shrubs at the Arboretum was killed (Fig. 19). Characteristic symptoms include the bleaching of leaves and the destruction of bark (Fig. 20).

There are several indirect effects of a severe winter that should be noted. Rabbits fed extensively on bark above the snow (Fig. 21). This sort of injury, of course, is obvious. Less obvious secondary effects may yet occur. Bark can be injured by exposure to the spring and summer sun as a result of the winter thinning of foliage. Limbs so harmed, or already weakened by cold injury, can fall prey to borers and other insects. Dead twigs and branches that are not removed in good time will become the initial substrates for canker and wood decay fungi.

Fig. 20. Ruptured bark of Boxwood.

Fig. 21. Rabbit damaged bark of *Magnolia liliflora.*

Although we cannot reverse the weather, we can protect shrubs and trees from further injury by careful pruning, shading, feeding, and timely applications of pesticides. It might be acknowledged also that the total damage would have been much worse had there not been a fine, deep insulating layer of snow that protected roots and low-growing shrubs. And, in the event our spring seemed excessively cool, inordinately overcast, and unobligingly slow in coming, our Swedish chronicler, Mr. Kalm, has words of comfort. "It is also true, however, that if the winters are at times hard, they do not last usually a great while. One can say properly that in Pennsylvania ordinarily they do not endure more than 2 months, and sometimes not that long. It is unusual if winter holds for as much as 3 months. Further, the summer heat is very strong and constant. In Pennsylvania, most of April, all of May, and the following months until October are as warm as June and July in Sweden. Cherries are often ripe in Philadelphia on the 25th of May; and, not infrequently, wheat is harvested in Pennsylvania by the middle of June. All of September and half, if not all of October, constitute the pleasantest season in Pennsylvania."[2]

[2] It is only fair to note that May 25 of his calendar would now be June 7.

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Arboretum Activities

The Staff

The Director attended the annual meetings of the American Association of Botanical Gardens and Arboretums which were held in Minneapolis on August 23 and 24. At the afternoon session of the first day he gave an illustrated talk on "The Registration of Cultivars in Magnolia."

Dr. Li has been awarded a Guggenheim Fellowship to further his studies on the Woody Plants of Formosa. He is spending six months at the University of California at Berkeley, where he is utilizing the herbarium resources of that institution in connection with this work.

Dr. Allison attended the meetings of the American Institute for Biological Sciences which took place at Purdue University, Lafayette, Indiana, from August 28 to September 1. En-route she collected some fungus cultures and slime molds for research as well as general mycological material for class use.

Gifts to the Library

The Arboretum Library has recently received two small but valuable collections of books and periodicals.

(*Continued on Page 47*)

Geographical Misnomers in Plants

Hui-Lin Li

In 1768, the British horticulturist Philip Miller in the eighth edition of his *Gardener's Dictionary,* described as *Xanthium chinense,* a cocklebur growing in London which he believed had originated in China. This was later found to be a mistake, and the original habitat was corrected to Vera Cruz, Mexico. In this case, fortunately, the misnomer was not continued in common usage, as it proved to be synonymous with the wide-spread *Xanthium strumarium* Linn.

Another New World plant bearing an Old World geographical name is *Canna indica* Linn., the Indian Shot. This name is still recognized and in general use. It is actually a plant of the West Indies and Central and South America, not of India, as Linnaeus indicated, although it is naturalized there. Still another is the common eastern American milkweed, which Linnaeus named *Asclepias syriaca,* supposing it to have come from the Orient.

Although such misnomers, in which New World plants bear Old World place names or vice versa, are relatively rare, there are numerous others with wrong geographical names. As a result the origin of the plants concerned is erroneously attributed to a different locality.

To the uninitiated a technical plant name in Latin is sometimes regarded as inscrutable and something to be avoided. Others believe the names represent absolute truth. Of course neither one of these points of view is entirely right. A botanical name is only a means and not an end in itself. That a certain number of these misnomers appear among the tens of thousands of names is no surprise to anyone familiar with the conditions and circumstances under which the system of naming plants has developed. The occurrence of these misnomers does not in any way debase our nomenclatural system. It is, however, imperative that there should be some understanding of these conditions for the effective use and appreciation of these technical names.

Binomial nomenclature

To begin with, a brief word about botanical names of species in general seems in order. The species is regarded as the basic unit of classification. Since each species bears a name consisting of two words, this system of naming plants is called binomial nomenclature. The first word is the name of a genus, in the form of a noun beginning with a capital letter. The second word is the specific epithet, generally in the form of an adjective conforming to the gender of the generic name. The author's name follows next and is often omitted in non-technical or general discourses. The specific epithet may be derived from sundry sources, such as a descriptive word, a personal name, a native plant name or a geographical place name. Here are some samples:

Lonicera japonica (Japanese Honey-suckle)
Pinus nigra (Black Pine)
Rosa Banksiae (Banks' Rose)

The technical name of a species can be roughly compared with the name of an individual, where the surname is equivalent to the generic name and the given name to the specific. The difference is that a botanical name is applied to a group of individuals of the same kind while a personal name is for one individual alone.

Principle of priority

A plant species may sometimes receive more than one name from different botanists studying the same species independently. To avoid confusion and to provide essential stabilization to technical names, a set of rules has been developed and agreed upon by botanists at the international level to govern the creation, adoption and use of all plant names. Among the basic principles upon which these rules are formulated is the so-called law of priority, that is, the oldest or the first name given to a plant should be the one adopted. Other names of later origin pertaining to the same plant are treated as synonyms.

Botanists also agree among themselves that the adoption of binomials begins with Linnaeus, the father of modern taxonomy and the originator of the binomial system of nomenclature in current usage. Linnaeus's *Species Plantarum,* 1753, is the starting date of species names for flowering plants.

Geographical misnomers

The advent of geographical misnomers is of course due to erroneous or confused notions about the original habitat of the plant concerned. This may be due to limited or incomplete information available to the author, but sometimes it may be due merely to his ignorance of geography. In any event, when a plant name is

Fig. 22. *Prunus tomentosa*

once proposed, and if it is the first name given to that plant species and established in accordance with all provisions of the rules of nomenclature, it is the name to be adopted. This includes also cases in which a geographical name may have been incorrectly applied.

At the time of Linnaeus many cultivated plants were already widely dispersed beyond their original range. Thus, when some of these plants received their first scientific names, they might not have been in their original habitat, a fact which sometimes may have escaped the notice of the author. This is the major source of geographical misnomers in plants.

Misnomers by Linnaeus

More geographical misnomers appear in earlier taxonomic literature than in more recent works. This is to be expected as our geographical knowledge today is far more advanced and complete than that of our predecessors of the eighteenth and even the nineteenth centuries.

Linnaeus's *Species Plantarum* is actually a flora of the world, though an overly ambitious and premature one. He attempted to cover all parts of the world, Old as well as New, where-ever he could obtain specimens either by himself or through his correspondents and students visiting and exploring distant countries. Among the plants he described are a number of familiar cultivated plants: *Salix babylonica* (Weeping Willow), *Prunus Armeniaca* (Apricot) and *Prunus Persica* (Peach), which Linnaeus believed had originated from Babylonia, Armenia and Persia respectively. These plants were later traced and found to be of Chinese origin, having been introduced into western Asia at earlier times. Although these names are not geographically appropriate, they are perpetuated because of the priority rule.

In describing his hundreds of species from many parts of the world, Linnaeus showed limited knowledge of eastern Asia. His records of India are mostly from the Malabar and Coromandel coasts of southern India, but may refer also to China. As a result he created a number of geographical misnomers which have ever since tended to confuse authors. These names are noted in some detail by Bretschneider (1898). More recently, Stearn (1957), in his introduction to a reprint of Linnaeus's *Species Plantarum*, says also, "Unfortunately Linnaeus seems to have confused China and India or regarded them as forming one region; he gave the epithet *indica* to Chinese species of *Daphne* and *Rosa* while recording them from China and the epithet *chinensis* to Chinese species of *Poa*, *Osbeckia*, *Dolichos*, etc. while recording them from India, as Bretschneider, (1898) pointed out."

A few of the more familiar plants under this category and still in current usage are: *Chrysanthemum indicum* Linn. (Garden Chrysanthemum), *Lagerstroemia indica* Linn. (Crape Myrtle), and *Rhododendron indicum* (Linn.) Sweet (based on *Azalea indica* Linn.). All these are plants of Chinese, not Indian, origin.

Planta japonica

The largest group of geographical misnomers belong to plants bearing the name "japonica" or its equivalent. These plants cause among horticultural writers more confusion than any other groups, because they are among the more widely planted ones of the temperate gardens. While most of the plants named "japonica" are of Japanese origin, a number of them have their natural habitat in China. These plants are among the many cultivated plants introduced into Japan in the middle ages.

Fig. 23. *Eriobotyra japonica*

Fig. 24. *Kerria japonica*

In these early times, there were close contacts between China and Japan and from the former the latter imported through the centuries many intellectual refinements as well as amenities, from the written language and painting to medicine and tea-drinking. Many plants were introduced either for medicinal purposes or for ornamental usage. These plants, under long and intensive cultivation, often developed distinct garden forms in Japan and became very much an integral part of the Japanese cultivated flora.

During the seventeenth and eighteenth centuries, both China and Japan were closely guarded against foreign intrusion. The Dutch were the only Europeans who succeeded in maintaining a few trading establishments in some Japanese ports. Fortunately for science, the Dutch, unlike their immediate predecessors in the Far East, the Spaniards and Portuguese, had with them a few scholars versed in medicine and botany. These few, such as the Bavarian Philip Franz von Siebold and Carl Peter Thunberg (a Swede), bestowed upon us a legacy of botanical and horticultural information about the Far East in the eighteenth and in nineteenth centuries.

Most of the plants observed by these authors were from the gardens in and around the cities. When they first described these plants, they believed them all to be indigenous to the country. Actually, a large number of the garden plants in Japan are introductions from China in former times. Among the familiar garden plants of Chinese origin, but described first from plants cultivated in Japan, are: *Edgeworthia papyrifera* Sieb. & Zucc., *Daphne Genkwa* Sieb. & Zucc., *Daphne odora* Thunb., *Ginkgo biloba* Linn., *Hypericum patulum* Thunb., *Prunus Mume* Sieb. & Zucc. (cover), *Prunus tomentosa* Thunb. (Fig. 22), *Spiraea prunifolia* Sieb. & Succ., and many others.

From these early authors, as well as others later on we now have a very large list of Chinese plants bearing the label "japonica". Many of these names have since been relegated into the synonymy of other names and hence are not in current circulation. The following is an enumeration of those which are still in use. The authorities for the native habitat are Makino (1951). Nemoto (1936) and Rehder (1940).

(1) *Ampelopsis japonica* Thunb. Vitaceae.

Name based on *Vitis japonica* Thunb. This is a handsome woody vine with lustrous dark green finely cut foliage and pale yellow flowers in summer. It is a relatively tender plant and is thus not hardy in more northern temperate regions. According to Makino, it was introduced from China in the Kyo-ho era (1716-1736). The root of this plant is used in medicine, and this may have been the original reason of its introduction.

(2) *Anemone japonica* Sieb. & Zucc. Ranunculaceae

There is some confusion about the application of the correct name to this anemone. The name now generally accepted is *Anemone hupehensis*. A detailed account of the history of this plant is given by Bowles & Stearn (1947). The plant is considered native to central China.

(3) *Chaenomeles japonica* and *Cydonia japonica*. Rosaceae

The genus *Chaenomeles* was formerly included in *Cydonia* but the two are now generally treated as distinct. As a result, there is some overlapping and confusion in the names between the two. *Chaenomeles japonica* Lindl., based on the name *Pyrus japonica* Thunb., is a Japanese plant long cultivated in Japan. *Cydonia japonica* Pers., based on *Pyrus japonica* Sims not Thunb., however, is a Chinese plant of long standing in

Fig. 25. *Sophora japonica*

the garden there but was introduced into the Japanese garden in the middle ages. This is now treated as a synonym of *Chaenomeles lagenaria* (Loisel.) Koidz. but the name *Cydonia japonica* is still commonly used in garden literature. The common name of the plant is Japanese Quince.

(4) *Clematis japonica* (Houtt.) Makino. Ranunculaceae

According to Rehder and others, *Clematis japonica* Makino, based on *Anemone japonica* Houtt., is a different plant from *Clematis japonica* Thunb. The latter is a Japanese plant, but the former, accepted by Makino and Nemoto and treated as a synonym of *Clematis florida* Thunb. by Rehder, is a plant of Chinese origin that occurs in Japan only in the cultivated state.

(5) *Eriobotrya japonica* (Thunb.) Lindl. Rosaceae

Name based on *Mespilus japonica* Thunb. The Loquat is cultivated extensively in southeastern China and also in southern Japan. According to Rehder, its original habitat was in central China. (Fig. 23)

(6) *Gynura japonica* Makino. Compositae

This is a cultivated perennial with deep yellow flowers in autumn. According to Makino, it originated in China and was long ago introduced into Japan.

(7) *Fortunella japonica* Swingle. Rutaceae

The Kumquat was, as noted by Makino and many other authors, introduced into Japan from China in former times. It is the most handsome citrus tree, a dwarf much branched bush with many small bright orange fruits.

(8) *Isatis japonica* Miq. Cruciferae

According to Makino, who adopted the name *Isatis indigotica* Fortune, this plant originated in China and was introduced into Japan in the Kyo-ho era (1716-1736). In former times this was an important source of blue dye in China.

It is perhaps of some ethnological significance that species of this genus were used of old both in Europe and Asia as a dye plant. *Isatis tinctoria* Linn., of southeastern Europe, the Dyer's Woad, was used by ancient Europeans as a blue dye. Before indigo became common in Europe, the Dyer's Woad was the main source of blue dye for woolen material. According to Caesar, the Ancient Britons used the coloring matter to stain their bodies and the word Britain itself is derived from an old Celtic word meaning painted.

(9) *Kerria japonica* (Thunb.) DC. Rosaceae

The name was based on *Corchorus japonicus* Thunb. This familiar yellow-flowered shrub is widely cultivated in China and Japan and, according to Rehder, its original habitat is in central and western China. (Fig. 24).

(10) *Mahonia japonica* (Thunb.) DC. ....Berberidaceae

Based on *Ilex japonica* Thunb. This Mahonia is often confused with the commonly planted *Mahonia Bealii* (Fort.) Carr. It is a more tender plant and rare in western gardens. According to Makino, this species originated in China and was introduced into Japan in the Ten-na (1681-1684) and Jo-Kyo (1684-1688) eras.

(11) *Nepeta japonica* Maxim. Labiatae

This is an annual with whitish or pale pink flowers in summer. It is generally cultivated as a medicinal plant. According to Makino, it original habitat is in China.

(12) *Nothosmyrnium japonicum* Miq. Umbelliferae

This is a perennial with small white flowers in autumn. According to Makino, it was introduced into Japan in former times. Its cultivation in Japan is now generally limited to botanical gardens and most probably it was originally introduced as a medicinal plant.

(13) *Prunus japonica* Thunb. Rosaceae

This is a bushy plant not very commonly cultivated. Makino states that it is a plant of China, introduced into Japan. Rehder gives more precisely its original home as central China.

(14) *Serissa japonica* Thunb. Rubiaceae

This is a small evergreen shrub generally cultivated as a greenhouse plant. It produces small white or slightly pinkish flowers in early summer. Makino notes that it is cultivated in Japan.

(15) *Sophora japonica* Linn. Leguminosae

Makino notes that this is a tree of China, introduced into Japan in former times. Variously name as Chinese Scholar Tree or Japanese Pagoda Tree, this is one of the most cherished trees in China and its cultivation dates back to prehistoric times. (Fig. 25)

(16) *Stemona japonica* Miq. Stemonaceae

According to Makino, this plant appears in Japan only in gardens and was introduced from China in the Tokugawa period in the 17th century. This is a climbing perennial herb with a tuberous root. Apparently it was originally planted as a medicinal plant only.

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Our Seeds go Traveling

Mention has frequently been made in these pages of the manner in which botanical gardens and arboretums throughout the world offer collections of seeds to each other. In this connection, however, emphasis has generally been placed on the benefits which accrue to us as a result of this exchange.

It is therefore the purpose of this account to call attention to the contribution which the Morris Arboretum makes to the needs of other institutions in this country and abroad.

The collecting of seeds for our annual distribution may begin as early as May when some of the elms and maples mature their samaras. A few forms, such as *Elaeagnus multiflora,* ripen their fruit in midsummer. But the real harvesting of seeds begins in August and continues throughout September and much of October. During these months the task of collecting falls largely upon the shoulders of Miss Anne B. Clifford, Assistant Propagator, and Miss Elizabeth V. Orsatti, of the Records Department.

Great care must of course be taken to insure that seeds are taken only from plants of known identity as well as to avoid instances of open pollination which would introduce possibilities of hybridization.

Seeds which are borne in dry fruits, such as legumes, pods or capsules, are relatively easy to prepare for shipment. On the other hand, those which are enclosed in fleshy bodies such as berries, drupes or pomes must be carefully freed of pulp and dried, a procedure which may require considerable time.

By mid-November most of our seeds have been collected and processed and are ready for distribution. Then comes the task, usually allotted to Miss Orsatti, of arranging for mimeographing the list of available species arranged by families and genera.

Early in December the list is ready for distribution. It is sent out in duplicate (one copy to be checked and returned, the other to be retained by the recipient) with a covering letter.

In 1960 our seed list was mailed to 226 botanical gardens and arboretums. Of these 48 were domestic and 178 were foreign. Requests for seeds soon began to arrive and continued to come in during the Spring and early summer of 1961. In all, 113 institutions (18 domestic and 95 foreign) have asked for a total of 1386 species from our offerings.

There follows a list, alphabetically arranged by countries, of the botanical centers outside the United States from which orders were received:

Australia: Adelaide, Victoria.
Belgium: Boncelles, Brussesl, Kalmthout, Liège.
Brazil: Canoas.
Bulgaria: Sofia.
Canada: Montreal, Toronto (2), Vancouver.
China: Hong Kong.
Czechoslovakia: Bratislava, Brno (3), Prague, Slepcany.
Denmark: Copenhagen.
England: Kew, Wisley.
Estonia: Tartu.
Finland: Turku.
France: Haute-Garonne, Lyon, Paris, Rouen, Verrières-Le-Buisson.
Germany: Berlin-Dahlem, Bonne, Bremen, Darmstadt, Dortmund-Brunninghausen, Dresden, Eberswalde, Frankfurt, Greifswald, Ham-Burg, Kiel, Köln-Riehl, Mainz/Rhein, Munden, Munich, Potsdam-Sanssouci, Rostock.

Fig. 26. *Pseudolarix amabilis*

Holland: Delft, Leiden, Nijmegen, Utrecht, Wageningen (2).
Hungary: Budapest, Godollo, Sopron, Szeged, Utja, Vacratot.
Italy: Milan.
Japan: Kobe, Koshigaya-Machi, Kyoto.
Jugoslavia: Ljubljana.
Latvia: Dobele, Riga.
Malta: Floriana.
Poland: Bydgoszcz, Polska, Rogow Kolo Koluszek.
Portugal: Porto, Sacavem.
Roumania: Din Cluj.
Scotland: Auchincruive By Ayr, Edinburgh, Glasgow, St. Andrews.
Spain: Valencia.
Sweden: Lund, Stockholm, Uppsala.
Switzerland: Basel, De Neuchatel, Champex, Geneva.
USSR: Ashkhabad, Batumen, Kazachstan, Kiev, Leningrad (2), Lvov, Minsk, Moscow (2), Stalingrad.

As a matter of interest, Miss Orsatti has compiled a "Popularity Poll" of the species offered on our 1960 list. The "winner" was the Golden Larch, *Pseudolarix amabilis,* (Fig. 26) which was requested by 39 institutions. In second place was *Fagus grandifolia caroliniana,* with 35 requests. Third place was achieved by *Halesia diptera* (Fig. 27) with 33 "votes"; fourth by *Pinus Bungeana* (Fig. 28) with 31, and fifth by *Halesia monticola* with 30.

Here, in descending order, are listed those species for which fifteen or more requests were received:

23 requests:
- Cornus Kousa
- Ilex decidua
- Pinus contorta
- Rhododendron prunifolium

22 requests:
- Acer palmatum
- Aesculus parviflora
- Cyrilla racemiflora
- Davidia involucrata
- Hamamelis intermedia

Fig. 27. *Halesia diptera*

Fig. 28. *Pinus Bungeana*

21 requests:
- Halesia monticola vestita
- Leucothoe editorum
- Rhododendron serrulatum

20 requests:
- Acer Buergerianum
- Halesia carolina
- Liriodendron Tulipifera
- Oxydendrum arboreum
- Pinus Griffithii
- Pinus parviflora
- Rhododendron viscosum montanum

19 requests:
- Acer palmatum sanguineum
- Cercis japonica
- Hamamelis mollis
- Ilex verticillata
- Rhododendron alanticum
- Rhododendron oblongifolium

18 requests:
- Acer palmatum heptalobum

17 requests:
- Actinidia arguta
- Carpinus japonica
- Hamamelis japonica flavo-purpurea
- Pinus Peuce

16 requests:
- Acer macrophyllum
- Cercis canadensis
- Rhododendron viscosum

15 requests:
- Cedrus atlantica
- Enkianthus perulatus
- Styrax Obassia

J. M. F., Jr.

Juvenile Variation in Five White Oak Species

Frank S. Santamour, Jr. and
Ernst J. Schreiner[1]

The Michaux Quercetum study is a joint project of the Morris Arboretum of the University of Pennsylvania and the Northeastern Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, financed in part by the Michaux Fund of the American Philosophical Society. One of the objectives of this project, as outlined by Schramm and Schreiner (1954), is to provide information on the variation within oak species.

Several papers have already been published on the Quercetum. Acknowledgments to seed collectors and outlines and progress of early work were reported by Schramm and Schreiner (1954) and Li (1955). Gabriel (1958) described juvenile variation in Shumard oak, and Santamour (1960) reported on the seeding performance of oak species from the southern and western United States. This is a report on juvenile variation observed in five white oak species, *Q. alba, Prinus, stellata, macrocarpa* and *lyrata*.

Methods and Materials

The methods of seed collection and nursery practice have been treated in some detail by Schramm and Schreiner (1954) and Li (1955). However, for the sake of completeness and for the benefit of those readers who might not have ready access to these papers, the highlights are repeated here.

Seed Collection and Shipment. For each species or variety, collectors were asked to supply 100-125 acorns from each of two typical trees growing in natural woodlands in their locality. The parent trees were to be so situated that they received adequate cross-pollination from other trees of the same species. The seeds were placed in polyethylene bags and shipped to the Arboretum immediately after collection. The acorns were stored in a refrigerator for a few days before they were planted.

Germination. Germination counts for the seedlots fall-planted in 1953 began on April 23, 1954, and continued at 2- to 5-day intervals until June 1. After this date observations on germination were made at the same time the seedlings were measured for height growth. No special determinations of early germination rate were made on the seedlots planted in 1954, but germination data were available from the seedling counts when the height measurements were made.

Nursery practice. Special seedbeds were constructed for this study with 14-mesh, galvanized window screen at a soil depth of 9 inches.[2] The wire screen prevented the development of the long taproots characteristic of the oaks, and thus greatly facilitated lifting from the beds. Seedlings of tap-rooted species grown on wire also develop a branched root system and more fine lateral roots than seedlings grown without wire.

The acorns were fall-planted one-half inch deep and the soil was covered with one-half inch of sawdust. Planting was at the rate of 25 to a row (1953) or 20 to a row (1954) in rows 4 feet long and 6 inches apart. Each seedlot was replicated twice and the seedbeds were mouse-proofed until after germination. The seedlots were planted in order of receipt, with no special attention to grouping by species. The 1953 seed was planted on 11 different days between September 28 and November 5; the 1954 sowings were done on 17 different days between September 28, 1954, and January 3, 1955.

The seedlings sown in the fall of 1953 were transplanted to nursery rows in early April, 1955. All seedlings, dead or alive, were transplanted because it was impossible to recognize winter damage at this time. The 1954 seedlots were transplanted in early May, 1956, when live and dead trees could be separated more easily. Spacing in the transplant beds was 18 inches between seedlings in rows 3 feet apart. The seedlots were grouped by species in the transplant nursery and each seedlot was kept in the same replicate in which it occurred in the seedbed.

Height Growth. Measurements of first-year height growth were made at four periods, and individual seedlings were tallied in 2-centimeter height classes. It was impossible to measure all of the seedlots in a single day. Depending on the weather and other factors, the length of time required to measure all the seedlings ranged

[1] Geneticist and geneticist-in-charge respectively, Northeastern Forest Experiment Station, U. S. Forest Service. The forest genetics research is in cooperation with the Morris Arboretum of the University of Pennsylvania.

[2] E. J. Schreiner saw wired seedbeds in use at the Nut Tree Nurseries, Dowington, Pa., in the late 1920's. It is not known whether Mr. John W. Hershey, owner of the nursery, originated this method for growing tap-rooted species.

TABLE 1.—DATA ON QUERCUS ALBA AND Q. PRINUS

Table 1.—Data on Quercus alba and Q. prinus

State	*County*	*Elev.*	*Growing season*	*Seedlot number*	*Germination*[1]		*Average height* *1-year*		*3-year*		*Autumn color ratings*[2] *1*		*2*		*3*	
		Feet	*Days*	*MQ–*	*Percent*		*Centimeters*		*Centimeters*		*Percent*		*Percent*		*Percent*	
					QUERCUS ALBA											
1953 Fall sowing					*6/1/54*											
Michigan	Cass	——	162	360		70		12.5		38.0		6		7		87
Tennessee	Knox	1000	217	213		90		19.5		51.8		26		48		26
Texas	Montgomery	200	260	012	57		24.5		71.9		100		0		0	
	"			009	63	59	18.0	21.3	63.6	67.8	100	100	0	0	0	0
1954 Fall sowing					*5/17/55*											
New Jersey	Somerset	100	165	519	71		7.2		22.8		47		22		31	
	"			520	92	86	10.7	8.5	22.4	22.6	6	21	7	13	87	66
Pennsylvania	Northampton	600	182	400	75		10.0		33.2		10		32		58	
	"			442	93	83	9.8	9.9	27.4	30.3	3	6	22	27	75	67
	Monroe	1900	127	540		64		8.3		26.2		53		15		32
Massachusetts	Middlesex	300	162	174	89		10.0		28.5		9		48		43	
	"			175	88	88	10.8	10.4	31.8	30.2	9	9	78	62	13	29
Virginia	York	——	205	533	77		18.2		43.9		71		27		2	
	"			535	50	62	7.8	13.0	29.3	36.6	85	78	14	20	2	2
Maryland	Prince Georges	200	178	575	88		14.5		35.1		20		73		7	
	" "			577	70	79	11.3	12.9	27.4	31.3	23	22	71	72	6	6
Maryland	Somerset	50	181	032		100		14.2		43.0		25		50		25
	Talbot	25	195	034		75		9.8		32.4		18		27		55
Arkansas	Stone	1000	215	263	100		10.2		36.8		12		15		73	
	"			267	100	100	10.9	10.6	27.8	32.3	0	8	9	13	91	79
Illinois	Hardin	500	192	463		100		12.4		28.2		13		13		74
North Carolina	Buncombe	2200	194	662		94		8.8		20.8		0		15		85
					QUERCUS PRINUS											
1953 Fall sowing					*6/1/54*											
Ohio	Ashland	——	157	352	77		20.1		72.1		4		59		37	
	"			353	65	74	15.0	17.6	54.2	63.2	20	8	67	60	13	32
Virginia	Montgomery	2100	168	109		97		23.9		68.5		3		86		11
1954 Fall sowing					*5/17/55*											
Massachusetts	Worcester	875	153	173		100		15.0		36.2		38		62		0
Connecticut	New Haven	75	195	189	100		16.8		38.9		48		38		14	
	" "			190	100	100	18.6	17.7	52.7	45.8	12	32	88	60	0	8
New Jersey	Camden	100	194	594		100		21.3		43.8		11		83		6
Pennsylvania	Monroe	720	127	443	100		18.2		39.4		5		46		49	
	"			444	97	98	16.8	17.5	37.1	38.3	6	6	48	47	46	47
	"	1900	127	539	100		14.6		42.7		75		21		4	
	"			541	100	100	18.3	16.5	51.1	46.9	14	28	48	41	38	31
Maryland	Prince Georges	250	178	578	100		21.9		52.8		10		89		1	
	" "			579	100	100	23.8	22.9	45.1	49.0	7	8	88	89	5	3
Ohio	Vinton	——	149	458	97		16.8		50.9		17		59		24	
	"			459	97	97	16.9	16.9	62.2	56.6	3	7	48	51	49	42
South Carolina	Berkeley	30	265	430		100		13.9		37.4		43		57		0

[1]Percent of total germination on the dates indicated.

[2]1 = green; 2 = red-, orange-, or yellow-green; 3 = red, brown, or fallen.

from 4 days to 2 weeks. However, measurements were made in the same sequence for each period, and when practical, all seedlings in a seedbed were measured on the same day. In 1954 the seedlings were measured in early June, mid-July, and late August; the final growth measurement for the 1-year-old trees in the seedbeds was made during the dormant season in February and March of 1955. The seedlots germinating in 1955 were measured in mid-May, early July, early August, and early November.

The percent of total first-year height attained

at each of the intermediate measurement periods was greatly confounded with germination rate. In one seedlot. August germination of a small number of seedlings reduced the average height to a figure below that of the July measurement. For this reason the variation in first-year growth pattern has not been included in this report.

Second- and third-year height measurements of the 1953 seedlots were made after growth had ceased in late fall. Lack of personnel prevented second-year measurement of the 1954 seedlots in the fall of 1956 and practically 100 percent of the trees were cut almost to ground level by rabbits during the winter of 1956-57. These seedlots were measured in the fall of 1957; the 3-year height therefore represents the re-growth of these trees following severe rabbit damage. All of these measurements were made in quarter-foot height classes.

Data on acorn weight were taken but unfortunately cannot now be located in the Michaux Quercetum files. There have been reports that acorn weight is correlated with juvenile height growth (Johnsson, 1952; among others). But we have seen no conclusive evidence regarding the extent to which seed weight in the oaks is under genetic control; to what extent it is the direct expression of the inherent vigor of the parent tree, or possibly the effect of xenia or metaxenia. It is possible that in this study height comparisons are confounded with differences in acorn weight.

Mortality. Seedling mortality for all seedlots was checked at the beginning of the second growing season, the end of the second year, and the end of the third year.

As noted above, transplanting of the 1953 seedlots was done at a time when the dead seedlings could not be distinguished. Thus the mortality observed after the trees had leafed out was a combination of winter-killing and transplanting losses. Li (1955) has pointed out that seedlings from the colder climatic regions averaged about five percent mortality after transplanting. Although there may be differences in transplantability between species, any mortality above five percent may possibly be interpreted as due to winter injury.

The seedbed area was fenced against rabbits and there was also no rabbit damage of any consequence to the 1953 seedlots in the transplant nursery. As noted previously, when the 1954 seedlots were 2-years-old, (winter of 1956-57) all of these seedlings were bitten off between ground level and a 3-inch stump. Mortality recorded after the trees had sprouted may therefore be a measure of the ability to recover from injury rather than inherent susceptibility to climatic conditions. Because of the extent and variability of the rabbit damage no attempt has been made to analyze 3-year survival of these seedlots for possible genetic differences between sources.

Data on stem dieback of the 1953 seedlots during the first winter were taken after transplanting in June, 1955. Because of the possible confounding of winter injury with transplanting damage no valid analyses for genetic differences could be made. The only information on first-year dieback of the 1954 seedlots was taken in November, 1955. At this time only the non-hardy species from the South and West had suffered damage from early frosts.

Autumn Leaf Color. Fall leaf color was recorded for each seedling between November 4 and 11, 1955. At this time the 1953 seedlings were two years old and the 1954 seedlings had just completed their first growing season. In order to increase the objectivity of these observations, all seedlings of a given replicate were scored by the same observer on the same day. Conclusions on unusual differences were checked by another observer.

There is some question as to whether fall-color determinations made on 1- and 2-year-old seedlings are directly comparable. In some species the first-year seedlings tended to lose their green color less rapidly than the older seedlings from similar areas. In other species, there appeared to be very little difference. For these reasons comparisons and conclusions regarding fall leaf color have been based on seedlings of the same age.

Analysis of the Data. The analysis of variance was used to determine differences between seedlots and localities for germination rate and height when there were more than 5 seedlots planted in a given year. With a smaller number of seedlots, comparisons were made using the t-test. For autumn leaf color, the departure from the average of all seedlots of a species planted in the same year was determined by chi-square tests. Additional analyses such as the correlation analysis and Keul's sequential sampling technique were used as mentioned in the text.

Discussion of Results

QUERCUS ALBA

Germination. Of the acorns sown in the fall of 1953 the Texas seedlots were the slowest to germinate; 59 percent of their total germination on June 1 as compared to 90 percent for the Tennessee lot (table 1). For the 1954 seedlots the percent of total germination on May 17, 1955, varied from 50 to 100 percent. The differ-

TABLE 2.—DATA ON QUERCUS STELLATA, Q. MACROCARPA AND Q. LYRATA

Table 2.—Data on Quercus stellata, Q. macrocarpa and Q. lyrata

State	County	Elev.	Growing season	Seedlot number	Germination[1]	Average height 1-year	Average height 3-year	Autumn color ratings[2] 1	Autumn color ratings[2] 2	Autumn color ratings[2] 3
		Feet	Days	MQ–	Percent	Centimeters	Centimeters	Percent	Percent	Percent
					QUERCUS STELLATA					
1953 Fall sowing					*6/1/54*					
Illinois	Cumberland	—	173	419	77	10.2	32.5	15	33	42
	"			423	81} 78	9.7} 10.0	31.0} 31.8	6} 12	28} 31	66} 57
Tennessee	Bledsoe	—	197	229	71	15.7	38.6	6	29	65
	"			230	57} 63	10.3} 13.0	40.6} 39.6	3} 4	53} 43	44} 53
Arkansas	Boone	1200	187	261	0	5.6	—	0	100[4]	0
	Ashley	180	227	296	16	7.6	37.6	30	50	5
Florida[3]	Putnam	75	314	335	10	9.7	35.1	24	48	4
1954 Fall sowing					*5/17/55*					
Missouri	Dent	1260	182	474	32	6.7	25.9	56	34	10
	"			475	22} 27	9.3} 8.0	35.4} 30.7	47} 52	53} 43	0} 5
Maryland	Prince Georges	175	178	580	56	11.7	27.5	13	68	19
	" "			581	65} 58	12.4} 12.1	35.5} 31.5	22} 18	78} 74	0} 8
Connecticut	New Haven	100	195	187	68	9.8	25.5	27	73	0
					QUERCUS MACROCARPA					
1953 Fall sowing					*5/7/54*					
South Dakota	Brookings	1700	136	185	67	13.5	62.9	6	17	77
	"			186	69} 68	14.9} 14.2	67.3} 65.1	3} 5	3} 9	94} 86
Kansas	Pottawatomie	1000	183	053	0	23.2	92.8	25	19	56
	Riley	1000	171	402	0	19.2	108.0	4	40	56
1954 Fall sowing					*5/17/55*					
Minnesota	Itasca	1300	111	354	84	11.6	44.2	0	6	94
	"			355	79} 82	10.2} 10.7	42.2} 43.2	11} 5	12} 9	77} 86
Illinois	—	—	—	543	27	25.0	83.3	64	36	0
					QUERCUS LYRATA					
1953 Fall sowing					*6/1/54*					
Mississippi	Tallahatchie	135	210	282	24	26.0	78.0	27	71	2
	"			283	25} 24	33.6} 29.8	88.9} 83.5	51} 37	49} 62	0} 1
Arkansas	Ashley	180	227	295	85	29.9	84.5	26	61	13
Texas	Houston	150	252	015	54	35.1	78.3	49	51	0

[1]Percent of total germination on the indicated dates

[2]1 = green; 2 = red-, orange-, or yellow-green; 3 = red, brown, or fallen

[3]*Q. stellata* var. *margaretta*

[4]Only 2 living trees

ences between seedlots were not statistically significant in either year because of random unaccountable variation.

Height Growth. For the 1953 fall sowing there was no significant correlation between first- and third-year heights and the analysis of variance failed to show any significant difference between seedlots for height in either year. For a more sensitive test of the differences between seedlots the average heights were compared by *t*-tests. The Michigan seedlot was significantly less vigorous than either the Tennessee or Texas progenies. Although the average height of the two Texas progenies was significantly greater than that of the Tennessee seedlot, one of the Texas progenies (009) did not differ significantly in height growth from the Tennessee seedlings. The two Texas seedlots were not significantly different. (Fig. 29).

The correlation between 1-year and 3-year heights was highly significant ($r = +0.740$) for the 1954 sowing. Although the correlation only accounts for approximately 54 percent of the variation associated with the correlated changes in 1-year and 3-year heights, 3-year height is apparently a fair measure of growth vigor in spite of the severe rabbit damage during the second winter.

There was no correlation between 3-year height and length of growing season of the parent-tree locality. Although there were no

Table 3. — *Quercus alba. Comparison of average three-year height growth*

Studentized range test[1]

State	County	Seedlot number	Average height
		MQ–	*Cm.*
North Carolina	Bumcombe	662	20.8
New Jersey	Somerset	520	22.4
New Jersey	Somerset	519	22.8
Pennsylvania	Monroe	540	26.2
Pennsylvania	Northampton	442	27.4
Maryland	Prince Georges	577	27.4
Arkansas	Stone	267	27.8
Illinois	Hardin	463	28.2
Massachusetts	Middlesex	174	28.5
Virginia	York	535	29.3
Massachusetts	Middlesex	175	31.8
Maryland	Talbot	034	32.4
Pennsylvania	Northampton	400	33.2
Maryland	Prince Georges	575	35.1
Arkansas	Stone	263	36.8
Maryland	Somerset	032	43.0
Virginia	York	533	43.9

[1] Brackets inclose means that are not significantly different at the 5 percent level.

statistically significant differences between the average 1-year or 3-year heights based on locality of the parent trees, there were highly significant height differences between seedlots for both years.

The seedlot means compared by the Studentized range test (Keuls, 1952) fall in four widely overlapping groups (table 3). Such grouping would indicate that the variation is not discontinuous, and since there is no geographic trend (either north-south or east-west) there is also no sound basis for postulating clinal variation. However, the data do provide evidence for probable local ecotypic differences and for significant individual variation within localities. The differences between the average 3-year heights of the two seedlots from Northampton County, Penna., Prince Georges County, Md., and York County, Va., were significant at the one percent level (*t-test*); the difference between the Arkansas seedlots was not significant.

Three-year survival. Survival of the individual seedlots at the end of three years varied from 50 to 89 percent and between localities from 58 to 85 percent. For the reasons noted previously the data do not provide evidence of genetic differences between the provenances that favor three-year survival in the Philadelphia area.

Autumn Coloration. On the basis of chi-square tests the autumn coloration of the seedlings from the following localities were signficantly different at the one percent level from the average for the respective years: Michigan; Texas; New Jersey; Northampton County, Pennsylvania; Massachusetts; Virginia; and Prince Georges County, Maryland.

An inherent potential for southern provenances to hold their green color late in the fall might be inferred from the data in table 1 for the Texas, Tennessee, and Michigan seedlots sown in the fall of 1953. The seedlots sown in the fall of 1954 do not show this clear-cut latitudinal variation. Although there is a tendency for southern origins to maintain green color later in the fall than northern seedlots, this latitudinal picture has several marked exceptions.

The North Carolina source is southern but none of these trees maintained completely green color (rating class 1); 85 percent of the trees in this progeny were red, brown or shed. The elevation of the parent trees of this seedlot is 2200

Fig. 29. *Q. alba* (MQ-009) from Texas appears to thrive under Philadelphia conditions.

feet. The Arkansas progenies from parent trees at an elevation of 1000 feet also had few green individuals (8 percent). The Pennsylvania progenies from Northampton ounty had 6 percent green trees and the Monroe County progeny had 53 percent. These two seedlots differ by thirteen hundred feet in the elevation of the parent trees. The percent of green trees was reasonably uniform in the Maryland provenances, but there was wide variation (27 percent to 72 percent) in trees rated 2. In this case there is little difference in elevation and in length of the growing season of the parent-tree locality.

There was also a wide range within localities (individual variation) in all rating classes. For rating class 1, for example, the values for the two progenies from New Jersey are 6 and 47 percent, the Pennsylvania progenies from Northampton County varied from 3 to 10 percent and the progenies from Stone County, Arkansas, varied from 0 to 12 percent.

The results of this study do not warrant the generalization that in the Philadelphia area autumn leaf coloration is later in progenies from southern parents than from northern origins. Such latitudinal correlation is indicated by the four 1953 seedlots, possibly because they represent continental provenances, but the 1954 seedlots, including maritime and continental provenances, depart drastically from this pattern.

The 21 progenies of *Q. alba* grown under the conditions of this study for three years have demonstrated wide genetic variation between the progenies of parent trees from the same locality. There is some indication of possible north-south variation between continental provenances, but the number of such provenances sampled is too small to be conclusive or to indicate whether such variation is continuous or discontinuous. The results also favor the conclusion that in this species genetic variation represents local ecotypes rather than clinal or racial differences.

Q. PRINUS

Data on this species are presented in table 1. The difference in percent of total germination between the 1953 fall-sown seedlots from Ohio (74 percent) and Virginia (97 percent) was significant at the one percent level. There were no significant differences in earliness of germination between seedlots (range 97 percent to 100 percent) for the 1954 fall sowing.

The difference in 1-year and 3-year height between the average of the two Ohio seedlots and the Virginia seedlots planted in 1953 was not significant. Although the Virginia seedlot was

Fig. 30. *Q. lyrata* (MQ-283) The dense, compact crown of young trees is quite distinct.

Fig. 31. *Q. macrocarpa* (MQ-409) from Kansas, 9 feet tall, has maintained its superiority over the South Dakota progenies.

significantly taller than Ohio 353 in both years, it was not significantly better than Ohio 352. The differences among the 1954 seedlots in 1-year height were signficant but the differences between localities were not significant. The differences in 3-year height were large but not significant for either seedlots or localities because of wide random fluctuations; it is apparent from the table that the differences within localities are nearly as large as those between localities. Since the correlation between 1-year and 3-year height was not significant it is possible that the rabbit damage in the second winter may be responsible for the lack of significant differences in 3-year height. (Fig. 33) .

The difference between localities in 3-year survival of the 1953 seedlots (Ohio 74 percent, Virginia 92 percent) was significant at the one percent level. For the 1954 sowing, three-year survival ranged from 48 percent to 100 percent. The confounding of survival with severe rabbit damage makes it impossible to estimate the importance of genetic differences responsible for the variation in survival between seedlots and localities.

For the 1953 sowing there was no significant departure from the averages in each of the 3 autumn color groups. Among the 1954 seedlots only the progenies from the low elevation provenance in Monroe County, Pa. and from Prince Georges County, Md., were significantly different from the average. The two seedlots from each of these localities were quite similar but in the other localities represented by two seedlots there were marked differences between the progenies, indicating considerable individual variation. In this species there appeared to be no association of fall color with origin, especially since the most northerly and the most southerly locations had the highest percentages of trees with green or red-green leaves.

On the basis of these data variation in *Q. Prinus* appears to result primarily from genetic differences between the parent trees. Racial or ecotypic variation is not apparent from this limited study.

Q. STELLATA

All of the collections of post oak planted in 1953 were typical of the species except the collection from Florida which was *Q. stellata* var. *Margaretta* (Ashe) Sarg., the sand post oak (table 2) .

Fig. 32. *Q. macrocarpa* (MQ-186) from South Dakota; specimens from this state are only 4 to 5 feet tall and appear more susceptible to insect damage.

For the 1953 sowing, the difference between seedlots and between localities in earliness of germination was highly significant. The Illinois and Tennessee seedlots began to germinate during the first week in May. The seed from Boone County, Arkansas, did not germinate until the first week in July and the total germination percent was quite low (6 percent). The percent of total germination on June 1, 1954, varied from 0 to 81 percent between seedlots, and from 0 to 78 percent between seed collection localities.

The five seedlots planted in 1954 also showed significant differences in percent germination on May 17, 1955. Between seedlots the range was from 22 percent to 68 percent, and between localities from 27 percent to 68 percent. Although the trend in both years was for earlier germination of seed from northern than from southern provenances, there was wide variation between the Boone County, Arkansas, progeny from 1200 feet elevation and the Ashley County, Arkansas, seedlot from 180 feet elevation.

For both the 1953 and the 1954 sowings, there were no significant differences between seedlots or localities in 1-year height or 3-year height.

The difference in survival between the 1953 seedlots (ranging from 0 to 78 percent) was significant. The late-germinating Boone County, Arkansas, source had completely disappeared by the end of the third year. For the 1954 progenies, survival following transplanting and rabbit damage was 62 percent for the Maryland source, 36 percent for Missouri, and 5 percent for Connecticut. Since it was not possible to determine to what degree each of these two factors was responsible for mortality there is no basis for estimating the importance of genetic differences as a factor responsible for survival.

There were significant differences between localities in autumn leaf color of the 1953 progenies. Only 43 percent of the Illinois seedlings and 47 percent of those from Tennessee showed some green in their leaves (rating 1 and 2) whereas 80 percent of the Ashley County, Arkansas, seedlings and 72 percent of the Florida plants still showed some green leaf color. There was also considerable variation between progenies from the same locality in several of the rating classes. In the 1954 seedlots, 92 percent or more of the seedlings from each of the three localities had green or red-green leaves (ratings 1 and 2). But there was greater variation in rating class 1; 52 percent of the Missouri, 18 percent of the Maryland, and 27 percent of the Connecticut seedlings had green leaves.

Although only eight different provenances were tested, there was a trend for earlier germination and earlier autumn coloration in northern seedlots. This may indicate clinal or racial differences in these characters. However, there were no significant differences in 1-year and 3-year heights. For the progenies tested, this character was more uniform in this species, both between and within localities, than in the other white oaks represented by as wide a sampling range.

Fig. 33. *Q. Prinus* (MQ-109) from Virginia is quite vigorous and free from insect attack.

Q. MACROCARPA

Two seedlots each from South Dakota and Kansas were planted in 1953. The climate in the areas of origin of these seedlots is so different that considerable variation might be expected. The 1954 sowing included two seedlots from Minnesota, and one seedlot from Illinois.

The South Dakota seedlings began to germinate on April 26, 1954, and by May 7, 68 percent of the final total had germinated (Table 2). The Kansas seedlots did not start germination until May 11. The Illinois acorns were slower to germinate than those from Minnesota; only 27 percent of the total had germinated by May 16, 1955, in contrast to 82 percent for the Minnesota source.

The height growth of the Kansas seedlings was significantly better than that of the South Dakota seedlot at the end of both the first year

(21 cm. vs. 14 cm.), and the third year (100 cm. vs. 65 cm.) in the nursery. The Illinois seedlings were taller than those from Minnesota at the end of the first year (25 cm. vs. 11 cm.) and after sprouting in 1957 (83 cm. vs. 43 cm.). The difference between these provenances was not significant because of the large variation between the Illinois replicates. (Figs. 31 & 32).

There were no significant differences in 3-year survival between seedlots planted in the same year. Survival of the 1953 seedlots was 93 percent to 100 percent; for the 1954 seedlots it was 78 percent to 88 percent.

The differences in fall leaf color for both years of sowing were highly significant. Forty-four percent of the Kansas seedlings had green or red-green leaves at the time of observation while only 14 percent of the South Dakota seedlings showed any green in their leaves. Although there was considerable difference between the two Kansas seedlots in the percentage of trees with green leaves, they did not differ in the percentage of trees showing some green color (ratings 1 and 2). All of the Illinois seedlings showed some green in their leaves (ratings 1 and 2), but only 14 percent of the Minnesota seedlings had green or red-green leaves.

The seedlots of this species, all from localities with continental climates, show the same pattern of north-south variation in earliness of germination, lower 1-year and 3-year height growth, and earlier fall coloration. The number of provenances is obviously too small to indicate whether these variations are clinal or discontinuous, or whether they indicate racial or local ecotypic differences.

Q. LYRATA

Although the range of *Q. lyrata* extends as far north as New Jersey and Delaware, the only collections in the Quercetum were from Mississippi, Arkansas, and Texas. All of these seedlots were remarkably similar in the characteristics studied with the exception of germination rate (table 2).

Percent of total germination on June 1 was 24 percent for Mississippi, 85 percent for Arkansas, and 54 percent for Texas. Since the latitudinal and climatic range of these seedlots was small the variation in germination rate may have been due to unknown internal and external environmental factors or possibly to local ecotypic variation. (Fig. 30).

Three-year survival between localities (71 to 89 percent) was not significant because of the wide difference between the two progenies from Mississippi (69 percent vs. 95 percent). Differences between 1-year and 3-year heights were also not significant and the progenies from the three localities did not differ from the average in autumn coloration.

The data on height growth, 3-year-survival, and autumn coloration may indicate individual variation between the two parent trees from Mississippi but the data did not provide evidence of genetic differences between localities.

Summary and Conclusions

This report covers a study of variation observed during 3 growing seasons between 21 single-tree progenies of *Q. alba*, 16 of *Q. prinus*, 12 of *Q. stellata*, 7 of *Q. macrocarpa*, and 4 of *Q. lyrata*. The seedlings were grown for one year in seedbeds and two years in a transplant nursery at the Morris Arboretum, Philadelphia, Pennsylvania.

The variables available for progeny comparisons were earliness of germination, 1-year and 3-year height growth, and autumn coloration. On the basis of these three variables, and with due consideration of the exploratory nature of this study and the limited sampling of the species, the authors offer the following conclusions:

1. In *Quercus alba* there was wide variation between progenies of individual trees. Although there was some indication of north-south variation between continental provenances, the results favored the conclusion that genetic variation represents local ecotypes rather than clinal or racial differences.

2. Racial or ecotypic variation was not apparent in *Q. prinus* from this limited study. There were differences between the progenies of individual parent trees.

3. There was a trend in *Q. stellata* for earlier germination and earlier autumn coloration in northern seedlots. Height growth of the progenies tested was more uniform in this species than in the other white oaks represented by as wide a sampling range.

4. The 7 seedlots of *Q. macrocarpa* from 4 continental localities showed a pattern of north-south variation.

5. The four seedlots of *Q. lyrata* from within a relatively small geographic area did not provide evidence of genetic differences between localities.

6. This study has shown the necessity for maintaining the identities of individual parent-tree progenies in provenance tests of these white oak species.

7. For genetic improvement in these species individual tree selection appears to offer more promise than ecotypic or racial selection.

Acknowledgements

The Michaux Quercetum has been a truly cooperative project since its inception. Personnel of the Morris Arboretum of the University of Pennsylvania, originally supervised by former director, J. R. Schramm, and now under the direction of John M. Fogg, Jr., have been responsible for nearly all the contacts with seed collectors and most of the nursery work. H. L. Li and Mary O. Milton have handled the accession records and herbarium specimens.

The measurement and evaluation phases of the project have been handled by the genetics personnel of the Northeastern Forest Experiment Station, U. S. Forst Service.

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Associates' Corner

The Climatron

As Arboretumites we are naturally interested in what the other fellow is doing, so hearing much of the new idea of a greenhouse constructed by the Missouri Botanical Garden in St. Louis, your chairman packed up the trusty station wagon and went to investigate. It was well worth the trip.

The building is called a Climatron because it is constructed to emphasize climate-control facilities. It is a geodesic dome made of aluminum tubing arranged in hexagonal patterns and lined with a layer of ¼ inch thick Plexiglass, 70 feet high and covers a little over ¾ of an acre. It is equipped with two automatic independent air circulation systems, with temperature, humidity and volume of air controlled by elaborate pneumatic switches and motors operating fans, dampers and water spray nozzles, so controlled they permit several different climates in separate parts of the building, from an Amazonian forest and bog area, an underwater tunnel (you don't need a snorkel to see the roots of the aquatic plants) to a tropical mountain forest and even an oceanic climate.

A gallery runs around the upper part of the building from which one can view the over-all, and leads down to the lower level where one can wander along paths and inspect the individual plants at close range. Loud speakers send forth the different cries of the tropical birds supposedly inhabiting this fantastic abode. They add to the atmosphere, but I missed the Howler Monkeys. Perhaps they thought the humans could make up for that noise.

Scattered through these forests are artificial trees made of steel pipes welded together and covered with black Osmunda fiber, an excellent substitute for tree bark, on which hundreds of orchids grew, many of them in flower.

Being drug conscious and proud of our own garden, I was interested to see *Strophanthus gratus* in their collection. Another intriguing plant was the Telegraph Plant (*Desmodium gyrans*) a member of the pea family, whose leaflets are in constant motion becoming more animated as the motion mounts. They seem to be signalling to each other; hence the layman's name for them. No one knows why or how they move. Here is a chance for one of us amateur botanists to discover the secret.

An amusing touch was a machine just under a group of Macadamia nut trees, containing the nuts. By placing a nickle in this machine you could get a nut and sample the taste for yourself.

The theory of the Climatron is to study the effect of climate on plant growth and at present much experimentation is going on with American corn. This is a quick survey of a fascinating and thrilling creation, one could spend days wandering from climate to climate studying all sorts of strange plant growth and the display of orchids alone is worth the trek to that charming city.

Marion W. Rivinus

Arboretum Activities

(Continued from Page 30)

Through the will of the late Mrs. W. Keating Johnson, long an Associate of the Arboretum, the Library acquired the back files of several important horticultural journals and a number of rare books. Among the latter were Tripp's "British Mosses" and a beautifully bound edition of Sullivant's "Icones Muscorum."

The second and larger collection was donated by Mrs. Philip P. Calvert of Cheyney, Pa. This consists of some 40 volumes and a number of sets of garden journals. Among the books are such interesting items as: "Aristocrats of the Garden" and "Plant Hunting" by E. H. Wilson, "Cultivated Evergreens" by L. H. Bailey, "Systematic Botany" by E. Warming, and Goebel's famous "Classification and Morphology of Plants."

Mrs. Calvert also presented us with two volumes of Photographs of Costa Rican Plants taken in that country in 1909 when she and her distinguished husband, who is Professor Emeritus of Zoology at the University of Pennsylvania, were writing their "Year of Costa Rican Natural History."

The Summer Course

For the seventh year in succession, the Director, aided by members of the Staff, offered a six-weeks' Summer Course on "Woody Plants." This course, conducted under the auspices of the Summer School of the University of Pennsylvania, was made up largely of high school teachers of science who were attending as participants of the National Science Foundation's Summer Institute. Also enrolled in the class were four graduate students of the University's Division of Landscape Architecture.

As in past years, the members of the class learned to identify, through laboratory and field studies, several hundred species of trees, shrubs and woody vines. Daily walks were taken around the Arboretum and visits were made to surrounding areas, including an all-day trip to the Pine Barrens of New Jersey. In addition to the regular lectures, specialized talks and demonstrations stressed the recognition and control of plant diseases and methods of plant propagation.

Some verses composed by a member of the class, who wishes to remain anonymous, seem to us to reflect so well the spirit of the course that, with his permission, they are reproduced here.

Here's to Doctor John M. Fogg, he who loves the Jersey bog
Quite as much as Arboretum's grassy slopes;
He has done his best to reach us — tried in vain at times to teach us
Always shoring up our oft'down-hearted hopes.

He has shown us *Rhus* and *Quercus* — they were quite enough to jerk us
From our self-complacent, lazy mental state.
Still we wondered — is it *Pinus?* Is the species *saccharinus?*
What will make a lusty *Ilex* want to mate?

Daily our poor mem'ries fail us — is it *occ* — or *orientalis?*
What about the somewhat hairy lower leaf?
Are they alternate and compound? Is the bud in sight or unfound?
Are those branched or unbranched spines? They brought us grief.

We have sniffed at *Phellodendron,* looked at old *Sequoiadendron,*
And enjoyed pronouncing *Liquidambar's* name.
We have stretched the leaves of *Cornus,* but you quite forgot to warn us
That your bees are miles away from being tame.

These were six good weeks — we liked 'em, as those many miles we hiked 'em
Over Morris Arboretum in the sun.
Here's a hope that you'll remember each and every doughty member
Of your Woody Plants of Nineteen Sixty-One.

Contributor's Fund

Several years ago there was established a Contributor's Fund to be used at the discretion of the Director of the Arboretum. Donations are tax exempt and those who contribute to this fund will enjoy the satisfaction of knowing their gifts will aid in the realization of some worthwhile project which could not otherwise be undertaken.

J. M. F., Jr.

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since June, 1961:

Sister Barbara Ann, O.S.F.
Mrs. Thomas H. Atherton
Mr. Robert J. Bell
Mrs. Helen M. Bogges
Mrs. Richard Brister
Mrs. C. Clausing
Mr. and Mrs. Richard Critz
Mrs. Clifford C. David
Mrs. Edward M. David
Mrs. Kenneth M. Eden
Mrs. George Eisenman
Mrs. Alice D. Gilliland
Mr. James P. Gilliland
Miss Mary E. Gindhart
Mr. and Mrs. M. H. Goldstein
Mrs. Kenneth Hassrick
Mrs. D. P. Hatch
Hill Hardware Company
Dr. Calvin F. Kay
Mr. Richard M. Lathrop
Mrs. Balduin Lucke
Mr. Edward Martin
Mrs. Jane E. Michie
Mr. Walter E. Miller
Mrs. Simon S. Nathan
Mr. George W. Purvis, Jr.
Dr. Elizabeth K. Rose
Mrs. Mary Lu Ross
Mr. C. Richard Snyder
Mrs. Paul W. Sutro
Mr. W. Welty
Mrs. Ernest Trachtenberg

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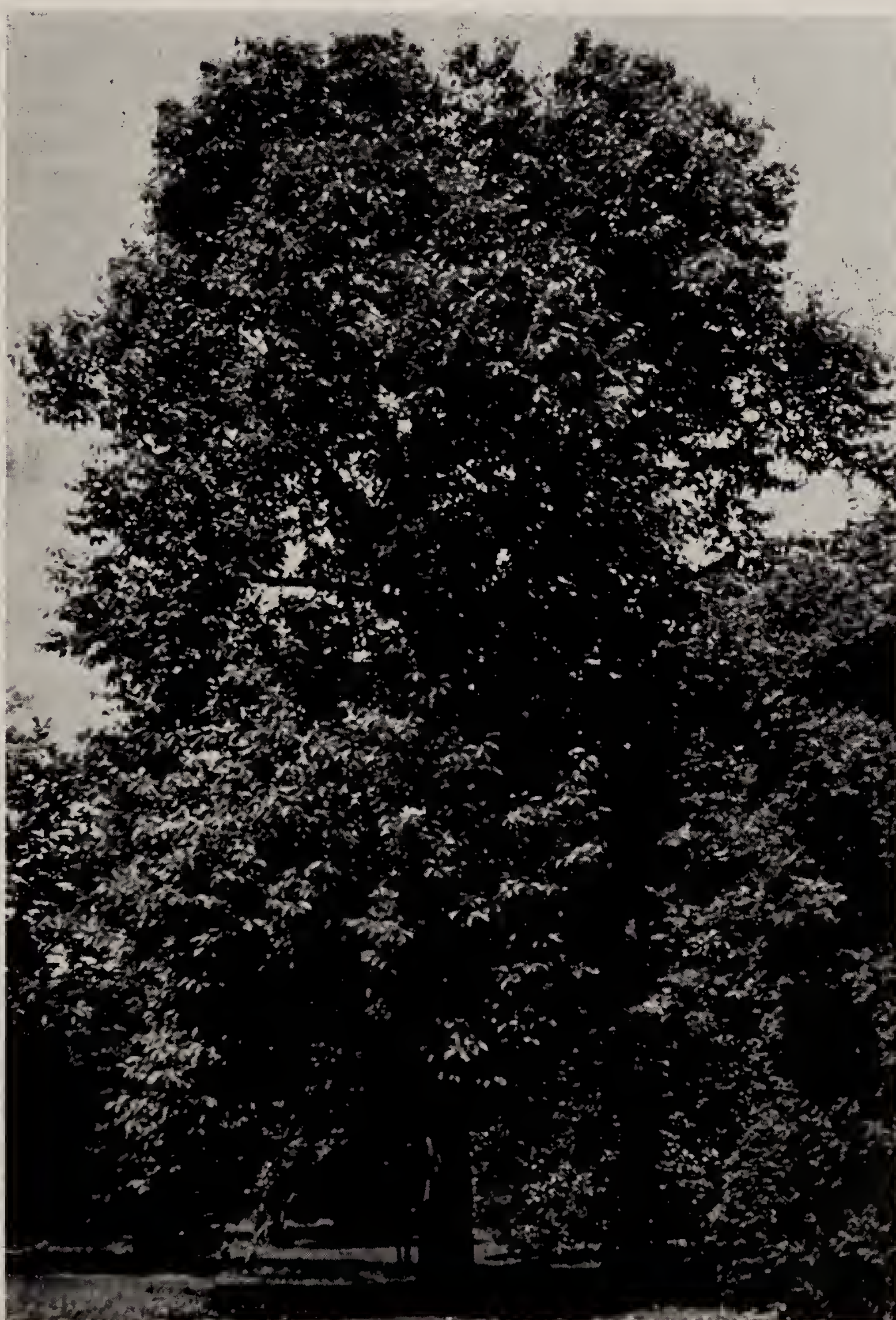

Magnolia acuminata

Published by
The ASSOCIATES of
THE MORRIS ARBORETUM

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

On Thursday, November 16, the Director gave an illustrated talk to the Philadelphia Botanical Club with the title "Glimpses of Florida and the West Indies." On December 6 he spoke at an evening meeting of The Faculty Club of the University; the subject of this lecture was "The Four Seasons at the Morris Arboretum."

Dr. Li writes from Berkeley, California, where he is spending six months on a Guggenheim grant, to say that his studies on the woody plants of Formosa are progressing well and that he is delighted with the rich resources of the herbarium at the University of California. On November 16 Dr. Li addressed the California Botanical Society on the topic of, "The Morris Arboretum and its Collection of Woody Plants."

Dr. Allison attended the annual meetings of the American Phytopathological Society which were held in Biloxi, Mississippi, from December 10 to 13.

We announce with regret the resignation, on November 30, of Miss Mary O. Milton who had been propagator on the Arboretum staff for more than five years. Miss Milton left in order to accept the position of Horticulturist at the Pennsylvania Horticultural Society.

(Continued on Page 70)

The Temperate American Magnolias

John M. Fogg, Jr.

Few trees hardy in northern climes can surpass the Magnolias in the size and beauty of their flowers. While it is true that the American species, in which the blooms are produced with or following the unfolding of the leaves, are somewhat less spectacular than those from Asia, in most of which the flowers precede the appearance of the foliage, nevertheless our native forms possess a distinction and charm which entitle them to a place in any collection of trees. One of them, *Magnolia grandiflora,* is probably as widely cultivated as any ornamental tree in the Northern Hemisphere.

Fig. 35. *M. grandiflora*

The Magnolia Family

The limits of the Magnoliaceae have varied over the years in conformity with the views of different authorities. According to earlier interpretations, the family contained about a dozen genera, including *Illicium, Schisandra, Tetracentron, Trochodendron, Kadsura* and *Drimys.* The present tendency, following Hutchinson (1926), Dandy (1927), and others, is to restrict it to *Magnolia, Liriodendron, Manglietia, Michelia* and *Talauma.* Of these only the first two occur in temperate North America.

Fig. 34. Fruits of *M. macrophylla* and M. × *Soulangiana*

It is worthy of note that many botanists regard the Magnoliaceae as one of the most primitive of all families of Angiosperms. In support of this view may be cited the woody habit, the simple leaves, the unspecialized character of the floral parts, and the numerous, free, spirally arranged stamens and carpels.

The discontinuous distribution of most modern representatives of the family is also an indication of antiquity, and parallels that of other groups of Dicotyledons which are likewise considered to be both primitive and ancient.

The Genus Magnolia

Magnolia was first described by the great Swedish botanist, Linnaeus, who named it in honor of Pierre Magnol, Director of the Botanical Garden at Montpellier.

In the first edition of Linnaeus's Species Plantarum, published in 1753, only a single species, namely, *M. virginiana,* is recognized, although the author, by the use of Greek letters, designates five varieties. In later works Linnaeus described *M. acuminata, M. grandiflora* and *M. tripetala,* all of them from North America.

At the present time the genus is generally regarded as embracing some seventy species. Of these nine are native to the Eastern United States, eight occur in Mexico and Central America, eight are indigenous to the West Indies, one is found in northern South America, and the re-

Fig. 36. *M. virginiana*

mainder (about 45) are Oriental, growing in a triangular area which extends from Japan across China to the eastern Himalayas and south to Java. (Dandy, 1950)

All Magnolias are trees or in a few cases shrubs, e.g. the Chinese *M. liliflora*. Most species are deciduous, but a few like *M. grandiflora* and *M. Delavayi*, retain their foliage throughout the year. The leaves are alternate, simple, often large and frequently interesting. Among the flowers, which are borne singly, are some of the largest and most spectacular of any group of trees found outside the tropics.

The perianth segments of Magnolias are usually in threes or multiples thereof. In those species in which the calyx is distinct from the corolla the number of sepals is generally three and the petals may number three, six, nine or even more. In other species, however, there is no clear difference in shape or color between sepals and petals and it is for this reason that the term "tepal" is frequently applied to the accessory organs of the flower.

The fruit is a cone-like structure formed of the numerous accrescent carpels. It is often large and showy, lending interest to the tree in late summer or autumn. The seeds which in most species are bright red are released when the carpels split open and usually remain attached by slender threads.

Classification

Of the several systems of classification which have been proposed for *Magnolia*, the one most widely accepted in this country is that of Rehder in his Manual of Cultivated Trees and Shrubs. According to this arrangement, the genus is divided into two subgenera: Magnoliastrum and Gwillimia.

In the first of these subgenera the flowers appear after the leaves, the fruiting body is symmetrical and somewhat cylindrical or globose, and the carpels are more or less distinctly beaked. The second subgenus is characterized by precocious flowers, unsymmetrical and somewhat twisted fruits and carpels which are not, or only rarely, beaked. Figure 34 clearly shows these two types of fruits as exemplified by *M. macrophylla* and *M. × Soulangiana*. All nine of the temperate American species belong to the first of these groups, the sub-genus Magnoliastrum.

Dandy (1950) also divides Magnolia into two subgenera, but places primary emphasis upon the manner of dehiscence of the anthers. In the subgenus Magnolia, as defined by him, the anthers open introrsely, i.e. toward the center of the flowers, while in the sub-genus Pleurochasma, they split laterally or sublaterally. Each subgenus is further divided into sections, a total of eleven being recognized. According to this arrangement two American species, *M. acuminata* and the closely related *M. cordata*, belong to the second subgenus, together with the precociously-flowering Asiatic *M. liliflora*. Small, following Spach, places these the two former species in the genus *Tulipastrum*, a division which Dandy reduces to the status of a section.

Cytologically the genus is extremely interesting. The haploid chromosome number is 19 and most species are diploid with a count of 38. However, *M. acuminata* is a tetraploid with 76, and *M. grandiflora* is a hexaploid with 114.

American Magnolias

The range of the genus *Magnolia* in temperate North America extends from central Florida to eastern Texas and Arkansas, north to New Jersey, western New York and southern Ontario. One species, *M. virginiana*, has a local outpost in eastern Massachusetts. All but one (*M. Ashei*) were described prior to the early years of the nineteenth century and all nine of them have found their way into horticulture in this coun-

Fig. 37. *M. macrophylla*

Fig. 38. *M. macrophylla*

try. Bean records all but *M. Ashei* as in cultivation in the British Isles.

The following artificial key, which is based solely on foliar characters, may help to differentiate those *Magnolias* which are indigenous to the eastern and southeastern United States.

A. Leaves coriaceous, persistent or semi-persistent.
  B. Leaves 15-20 cm. long, brownish beneath, firm-coriaceous and always persistent *M. grandiflora*
  B. Leaves 10-15 cm. long, whitish beneath, thin-coriaceous, semipersistent *M. virginiana*
A. Leaves not coriaceous, deciduous.
  C. Leaves auricled or heart-shaped at the base.
    D. Leaves glaucous beneath; more or less evenly spaced along the branches.
      E. Leaf-blades 5-8 dm. long, pubescent beneath .... *M. macrophylla*
      E. Leaf-blades 4-6 dm. long, sparingly pubescent beneath ...... *M. Ashei*
    D. Leaves pale green but not glaucous beneath, conspicuously clustered toward the tips of the branches.
      F. Leaves elongate-obovate, gradually pointed at the apex ..... *M. Fraseri*
      F. Leaves rhombic-obovate, abruptly acute at the apex ... *M. pyramidata*
  C. Leaves not auricled or heart-shaped at the base.
    G. Leaf-blades obovate to oblanceolate, 3-6 dm. long .... *M. tripetala*
    G. Leaf-blades elliptic to ovate or oval, 1-3 dm. long.
      H. Leaf-blades elliptic to ovate, acuminate at apex, 1.5-3 dm. long *M. acuminata*
      H. Leaf-blades oval or orbicular-oval, rounded at apex, 1-1.5 dm. long *M. cordata*

M. GRANDIFLORA L. (*M. foetida* (L.) Sarg.) Bull Bay, Loblolly Magnolia.

This is a tree of noble proportions, capable of achieving a height of some 30 m. (about 100 ft.). The coriaceous, oblong or elliptic leaves are 15 to 25 cm. (6 to 10 ins.) long, lustrous on the upper surface and usually brownish-pubescent beneath. The creamy, white, fragrant flowers are from 15 to 20 cm. (6 to 8 ins.) across. (Fig. 35). Here at the Arboretum the first flowers usually appear during the last week of June and the tree continues to bloom during the entire month of July and even into the first week of August. Few trees hardy in our area enjoy such a protracted period of blooming.

The natural range of this species is from Central Florida to Texas and Arkansas, thence north to North Carolina. Fortunately for many of us, it is hardy as far north as Philadelphia and even New York, although north of Washington it seems to require a somewhat protected situation.

Since *M. grandiflora* is almost the only tree with evergreen leaves and handsome flowers which can be grown throughout warm to cool temperate regions, it has in a period of more

Fig. 39. *M. Ashei*

Fig. 40. *M. Fraseri*

than two centuries achieved a truly world-wide popularity. According to Dandy, it was introduced into Europe as early as 1732. Today it is found in practically every garden in the British Isles and western Europe, including, of course, the Mediterranean area. Some of the largest specimens I have ever seen in cultivation are in one of the world's oldest botanical gardens, namely, that at Padova, Italy. Equally fine ones are growing in the Botanical Garden at Pisa. In such remote countries as India and Japan our American Bull Bay is highly valued as an ornamental and in the latter country in particular it is widely planted along the shores of ponds and streams in gardens and public parks.

Everyone who has observed *M. grandiflora* growing either in the wild state or in cultivation is aware of its tremendous capacity for variation. This is reflected in the habit of the plant, the shape, size, color and pubescence of the leaves and the character of the flowers. Some of these variations were first recognized in native populations, such as Pursh's var. *elliptica* and var. *obovata,* which were based on leaf shape. These may be regarded as botanical varieties. Many more have been detected and described from plants in cultivation and are known as cultivars[1]. Most of the early cultivars of *M. grandiflora* were identified in England and Europe. In recent years American growers have recognized an increasing number of individuals as worthy of description.

As noted in a previous issue of this Bulletin, I have accepted the assignment of registering all cultivar names in Magnolia[2]. To date I have recorded over 30 such names in *M. grandiflora* alone. A discussion of these will appear in a future publication.

[1] For a discussion of the distinction between cultivar and variety see Fogg. Morris Arb. Bull. 12:7. 1961.

[2] See Fogg. International Registration of Plant Names. Morris Arb. Bull. 12:17. 1961.

M. VIRGINIANA L. (*M. glauca L.*) Swamp Magnolia, Sweet Bay

A small to medium-sized tree said to attain a height of 20 m. (more than 60 ft.) but usually lower. The subcoriaceous, oval to broadly lanceolate leaves, which average 10 to 15 cm. (about 4 to 6 ins.) in length, are dark green above and whitish beneath. When young the under leaf surfaces may be silky-pubescent, but as the season progresses they tend to become entirely smooth, although retaining their glaucous hue.

The white, fragrant, subglobose flowers which are about 5 to 7 cm. (2 to 2½ ins.) in diameter appear in this area toward the end of May and continue to open for the next three or four weeks. The bright red fruits and scarlet seeds produce a brilliant effect against the lustrous foliage in late August. (Fig. 36)

The Swamp Magnolia extends from Florida and Mississippi north to Pennsylvania, New Jersey, and locally to eastern Massachusetts. A more southerly form, known as var. *australis* Sarg., is taller (up to 30 m.) and possesses more pubescent branches and foliage. There is a tendency in some quarters to apply this varietal name to any individual in which the leaves are persistent, but this characteristic was not embodied in Sargent's description. The evergreen form is more appropriately known as var. *sempervirens*, a name which has been in use since the early years of the nineteenth century.

M. virginiana is an extremely useful species. Although primarily a plant of low, wet woodlands, it flourishes in a wide variety of situations. It is attractive at all seasons of the year and well deserves the popularity which it has achieved in this country and abroad. It was the first Magnolia in cultivation in Europe, having been introduced in 1688, and has ever since been a universal favorite.

Fig. 41. *M. Fraseri*

Fig. 42. *M. pyramidata*

M. MACROPHYLLA Michx. Great-leaved Magnolia, Large-leaved Cucumber Tree.

Although this Magnolia conveys the impression of massive size it is seldom more than 16 m. (about 50 ft.) tall and most individuals in our area are appreciably smaller. The sense of bigness derives in large measure from the huge leaves, which have the largest simple blade of any tree in temperate North America. Leaves 8 dm. (about 30 ins.) in length are not unusual in the wild, although specimens cultivated in the north tend to be somewhat smaller, seldom exceeding 6 dm. (about 24 ins.). The leaves are whitish and finely pubescent beneath, with a prominently auricled base. (Fig. 37)

The flowers of this species parallel the leaves in size and are the largest of any Magnolia hardy in our area, frequently achieving a diameter, when fully open, of 2 to 3 dm. (8 to 12 ins.). The petals are six in number and the three inner ones are blotched with purple at the base. (Fig. 38). The fruit is an attractive rose-colored, globose, cone-like structure. (Fig. 37)

M. macrophylla was first described by the elder Michaux from North Carolina and is today known from that state to western Florida, west to Louisiana and north to Kentucky. It is, however, hardy as far north as eastern Massachusetts. Several fine specimens may be seen here at the Arboretum as well as elsewhere in the Philadelphia area. The species is worthy of a place in any garden which can afford it ample space in which to develop and be appreciated.

M. ASHEI Weatherby.

This is a newcomer to the ranks of temperate American Magnolias, having been described by Mr. C. A. Weatherby from western Florida in 1926. The species is closely related to *M. macrophylla,* which it resembles in its auriculate-based leaves, which are whitish on the under surface. However, the leaves of *M. Ashei* are somewhat smaller and, when mature, are less pubescent on the lower surface. There appears to be some discrepancy concerning the size of the flowers. Weatherby and Small both state that they are larger than those of *M. macrophylla;* Coker and Totten say that they are much smaller. Most authorities agree that the fruiting body of *M. macrophylla* is globose whereas that *M. Ashei* is cylindrical. There are also differences in the size of the seeds.

Although this species is best known from western Florida, it grows well in our area and is hardy as far north as New York. Magnificent specimens are in cultivation in the gardens of the Henry Foundation at Gladwyne, Pa. (Fig. 39). Despite the fact that it is said to be a smaller tree than *M. macrophylla,* the plants at Gladwyne bid fair to rival that species in size.

MAGNOLIA FRASERI Walt. (*M. auriculata* Lam.) Ear-leaved Umbrella Tree.

This and the following species have leaves which are auriculate at the base and so closely clustered at the ends of the branches as to appear whorled or verticillate. (Fig. 40). *M. tripetala* also has its leaves arranged in this manner, but the leaf in that species tapers gradually toward the base.

M. Fraseri is a slender tree up to 15 m. (about 50 ft.), which grows in swamps and bottomlands from Georgia and Alabama north to West Virginia and Virginia. The obovate-spatulate leaves are gradually pointed at the apex, pale green and glabrous beneath, and from 2 to 5 dm. (8 to 20 ins.) long. The creamy white and very fragrant flowers are about 2 to 2.5 dm. (8 to 10 ins.) across. (Fig. 41). In our area they open usually during the first week in May.

Fig. 43. *M. tripetala*

This species flourishes well in the Philadelphia region and is hardy as far north as Massachusetts. The two illustrations reproduced here were made from a fine specimen growing at the Barnes Arboretum in Merion, Pa.

M. PYRAMIDATA Bart. Bartram Magnolia.

Closely related to the preceding, this is a somewhat smaller tree, up to 10 m. (about 35 ft.) with a more restricted range. The leaves are rhombic-obovate and abruptly acute, rather than gradually pointed, at the apex. Moreover, the petioles are from 2 to 4 cm. (1 to 2 ins.) long, whereas those of *M. Fraseri* are appreciably longer. The flowers and fruit are also smaller than those of the foregoing species. (Fig. 42).

According to a map which Dr. Carroll E. Wood, Jr., of the Arnold Arboretum, has kindly furnished me, *M. pyramidata* occurs in southwestern Georgia, the panhandle of Florida, southern Alabama and southeastern Mississippi. A letter recently received from Dr. G. H. Ware of the Department of Botany, of the Northwestern State College of Louisiana, states that it also grows in Vernon Parish, Louisiana, as well as in southeastern Texas.

This species appears perfectly hardy in the Philadelphia area where it flowers a few days later than *M. Fraseri.* It deserves to be more widely grown than is apparently the case.

M. TRIPETALA L. (*M. Umbrella Lam.*) Umbrella Magnolia, Umbrella Tree.

This Magnolia is a small tree, seldom more than 10 m. (about 35 ft.), of somewhat sporadic occurrence in rich woods from Georgia to Arkansas and north to West Virginia and Pennsylvania. Its seemingly whorled leaf clusters, large white flowers and handsome pink fruits make it a conspicuous plant in the wild and a favorite subject in cultivation.

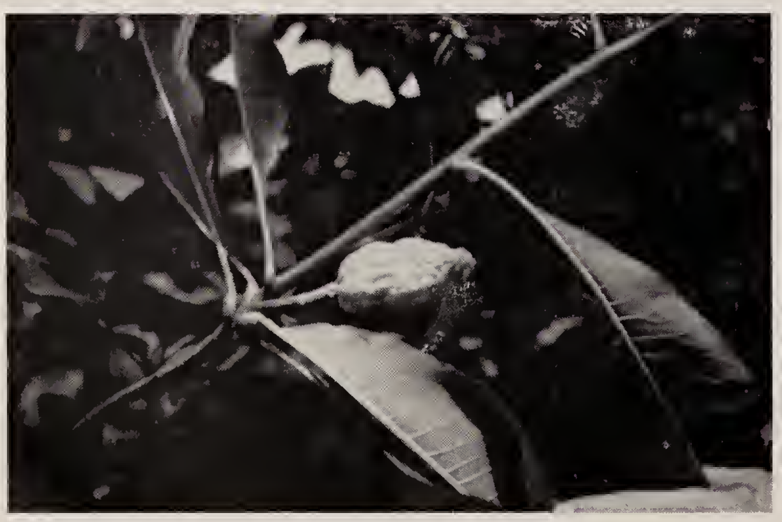

Fig. 44. *M. tripetala*

Fig. 45. *M. acuminata*

The oblong-obovate leaves are from 3 to 6 dm. (12 to 24 ins.) long, whitish and pubescent (at least when young) beneath, and gradually tapered at the base.

The chalky-white flowers which are about 2 to 2.5 dm. (8 to 10 ins.) across, exude a rather unpleasant odor. With us they usually open between the middle and the end of May (Fig. 43). The three large petal-like sepals (which give the plant its specific name) are reflexed and the six or nine petals are somewhat oblanceolate. The cylindrical fruiting bodies which are about 7 to 10 cms. (3 to 4 in.) long, begin to turn pink toward the middle of August and from then until frost are extremely ornamental. (Fig. 44).

M. tripetala is occasionally confused with the closely related Japanese *M. obovata.* In that species, however, the leaves are slightly rounded, rather than gradually tapering, at the base and the creamy white petals are spatulate.

The Umbrella Tree is a fast grower and with us exhibits something of a weedy tendency, becoming readily naturalized in moist shady situations, not only in the Arboretum but elsewhere throughout the area.

M. ACUMINATA L. Cucumber Tree.

This widely distributed species, which ranges as far north as western New York and southern Ontario, may attain a height of 30 m. (about 100 ft.). Its oblong-ovate leaves are 1.5 to 3 dm. (6 to 12 ins.) long, light green and usually slightly pubescent beneath, and acute or short-acuminate at the apex. The campanulate to globose flower is 7 to 8 cm. (about 3 ins.) high. (Fig. 45). The three sepals are glaucous-green in color and the six petals are greenish-yellow.

The common name of this species derives from the shape and color of the young fruit which, with some exercise of the imagination, may be thought to resemble a small cucumber.

Although the flowers of this species are far from showy, the tree has great value in horticulture because of its fine proportions and good foliage. In autumn the golden-yellow color of the leaves makes it one of the most showy of all the Magnolias.

Ashe and Sargent have described varieties of *M. acuminata,* based upon differences in the size, shape, and color of the leaves. It is my own feeling that this species is no more variable than other members of the genus and distinctly less so than *M. grandiflora.*

M. CORDATA Michx.

Similar to the preceding (of which it has by some been considered only a variety), but a smaller tree, seldom over 10 m. (35 ft.), with leaves which are shorter, broader and more rounded at the apex. (Fig. 46). The leaves may also be somewhat cordate at the base, whereas those of *M. acuminata* are broadly rounded or acute.

The flowers of this plant are slightly smaller than those of *M. acuminata* and the petals are a bright canary-yellow. This species was originally discovered by the elder Michaux in the neighborhood of Augusta, Georgia, probably around 1790. It was introduced into cultivation in France soon after and all the trees growing in Europe are believed to be derived from the original introduction.

According to E. H. Wilson, this tree was lost sight of in the wild between the time of its discovery and 1926 when Mr. Louis A. Berckmans happened upon it in a dry wood some 18 miles north of Augusta.

Despite its restricted southern range, *M. cordata* is hardy as far north as the Arnold Arboretum. Since it is the only member of the genus, suitable to our climate, in which the flowers are a true yellow it merits a place in any collection of woody ornamentals.

Fig. 46. *M. cordata*

Fig. 47. *M.* × *Thompsoniana*

Hybrids

Although no natural hybrids have been reported *in Magnolia,* garden crosses are well known. The most familiar of these is, of course, *M.* × *Soulangiana,* an intersectional cross between two Asiatic species, *M. denudata* and *M. liliflora,* which is believed to have occurred spontaneously in the garden of the Chevalier Soulange-Bodin near Paris in or about 1820.

According to Dandy (1950), there is no example of hybridization between the two subgenera, but there are several hybrids between different sections of the same subgenus.

Among the American species the most venerable cross is the one now called *M.* × *Thompsoniana,* which is a hybrid between *M. tripetala* and *M. virginiana.* This cross, which appeared in Mr. Thompson's garden in Mile End, London, in 1808, has also been referred to as *M. major* or *M. glauca major.*

The leaves of this hybrid have the glossy upper surface of *M. virginiana,* but are appreciably larger than those of that species. The flowers, on the other hand, are larger than those of *M. virginiana* although smaller than those of *M. tripetala* (Fig. 47).

M. × *Thompsoniana* must be regarded as only semi-hardy in the Philadelphia area. Our material has been subject to severe winter injury during the last decade and a half.

We obtained scions of this cross from the Barnes Arboretum, Merion, Pa., in 1945. Shortly afterward the Barnes material was winter-killed and we were pleased to be able to supply them with rooted cuttings. In the winter of 1958-59 our material was severely damaged and we thought that once again we would be forced to seek help from Merion. One plant, however, has made a good recovery and even flowered during the summer of 1961.

Still another intersectional cross, or rather series of crosses, namely *M. grandiflora* × *virginiana*, is reported by Rehder to have originated in 1930. Although *M. virginiana* is a fairly stable species, *M. grandiflora*, as already indicated, is extremely variable. However all of the progeny known to us have the coriaceous, evergreen leaves of *M. grandiflora*.

In recent years this cross has been repeated at a number of institutions, notably the National Arboretum in Washington, and we are growing a representative series of these at the Morris Arboretum. So far none has flowered.

Magnolias at the Arboretum

All nine species and two hybrids of temperate American Magnolias are in cultivation at the Morris Arboretum. A few, like *M. macrophylla, M. grandiflora, M. virginiana, M. tripetala,* and *M. acuminata,* have been here for many years and are well developed, mature individuals. Most of the others have been recently acquired and have yet to give a full account of themselves.

Two separate and very diverse sites have been selected for the growing of our Magnolias. One is a low, flat protected area along Hillcrest Avenue at the foot of the Azalea Meadow. The other is an open, north-facing hill-slope along Meadowbrook Avenue south of the service entrance.

It is interesting to note that Magnolias seem to survive equally well in both situations, but that the unprotected north slope has one advantage over the more selected area: namely, the plants in the former site are somewhat retarded in their early spring development with the result that they frequently escape the deleterious effects of a sudden cold snap which would otherwise have blackened the young buds.

We are still learning much about the adjustment of these interesting plants to our local conditions and intend to try them out in a variety of other habitats.

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New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since September, 1961:

Mr. Parker Biery
Dr. George C. Buzby, Jr.
Mr. & Mrs. Wm. L. Chapman, II
Mrs. Kathryn E. Darby
Mr. Christopher Davis
Mrs. James B. Drinker
Mr. and Mrs. Herbert Edwards
Mr. Robert W. Evleth
Mrs. John L. Fearey
Mr. William Logan Fox
Mrs. Milton Laden
Mrs. Paul Lewis
Mrs. William Draper Lewis
Mr. A. Douglas Oliver
Dr. and Mrs. Donald V. Rhoads
Mr. A. C. Serrell
Mrs. Walter Smedley
Dr. Louis Spitz
Mr. and Mrs. John Stump
Mr. Albert M. Suggs
Dr. Robert N. Swartley

Five Fall Fungi

Patricia Allison

Recognition of the importance of the fungus flora of an aboretum can never be far from the minds of individuals whose concern is the well-being of the woody plants under their care, cultivation and study. Unfortunately, it is most often a harmful activity of a fungus that brings this recognition to the surface. For instance, ordinarily inconspicuous leaf spot fungi may cause sudden epidemics that threaten the safety of certain species of trees. Such are the fungi causing anthracnose of species of *Platanus, Juglans, Acer* and *Quercus*. Then there are those pathogens that must be battled year in and year out to prevent the destruction of valuable host plants. Such a war is waged every year in the rose garden against the fungi causing black spot, powdery mildew and stem cankers, and in the greenhouses where tender cuttings are subject to attack from soil inhabiting fungi. Still other fungi are all about, ready to invade the inner core of any tree or shrub that has had its protective mantle of bark and living wood ruptured by storm or accident.

Nevertheless, there are fungal activities other than parasitism that, if not obviously beneficial, are at least of biological interest. A consideration of some of these other varied aspects of the fungal flora of the Morris Arboretum and its environs has proceeded almost continually since the moment the legacy was dedicated, on June 2, 1933. On that date, honorary degrees were conferred upon three distinguished scholars who had been invited to take part in the ceremonies. One of these men was President Abbott Lawrence Lowell, of Harvard University. Another was Dr. Robert A. Harper, Torrey Professor Emeritus of Botany, Columbia University. The third was Dr. A. H. Reginald Buller, Professor of Botany, University of Manitoba, whose address was entitled "Fungi in their Relations with Trees." A section of his talk dealt with disease, to be sure, but others concerned some interesting features of the fungi that cause decay of leaves and wood. Except that some of these fungi might also cause decay of the nonliving heartwood of standing trees, referred to earlier, and thus be harmful, their digestion of leaves and wood is in the main beneficial, for it rids the earth of waste and helps render wood substances once more available to living organisms. As a matter of fact, this cycle that proceeds from living tree to dead wood and back to living organisms can be very rapid, for the fungus fruiting bodies themselves constitute a major source of nourishment to many woodland creatures. Insects, molluscs, mites and mammals are known to consume them. So we come to the first two of our five fall fungi.

POLYPORUS FRONDOSUS and *P. SULFUREUS*

Even though the resemblance may seem remote, these two species are in the same large taxon as the mushroom we in the United States purchase in the grocery store. Their vegetative structure consists of miles upon miles of slender filaments that ramify in the woody substrate. Their characteristic fruiting bodies first appear on the surface of the wood as large mounds of solid flesh. (Fig. 48) As growth continues, caps or horizontal shelves begin to differentiate until in maturity there is a crowded cluster of them. On the lower surface of each of the caps or

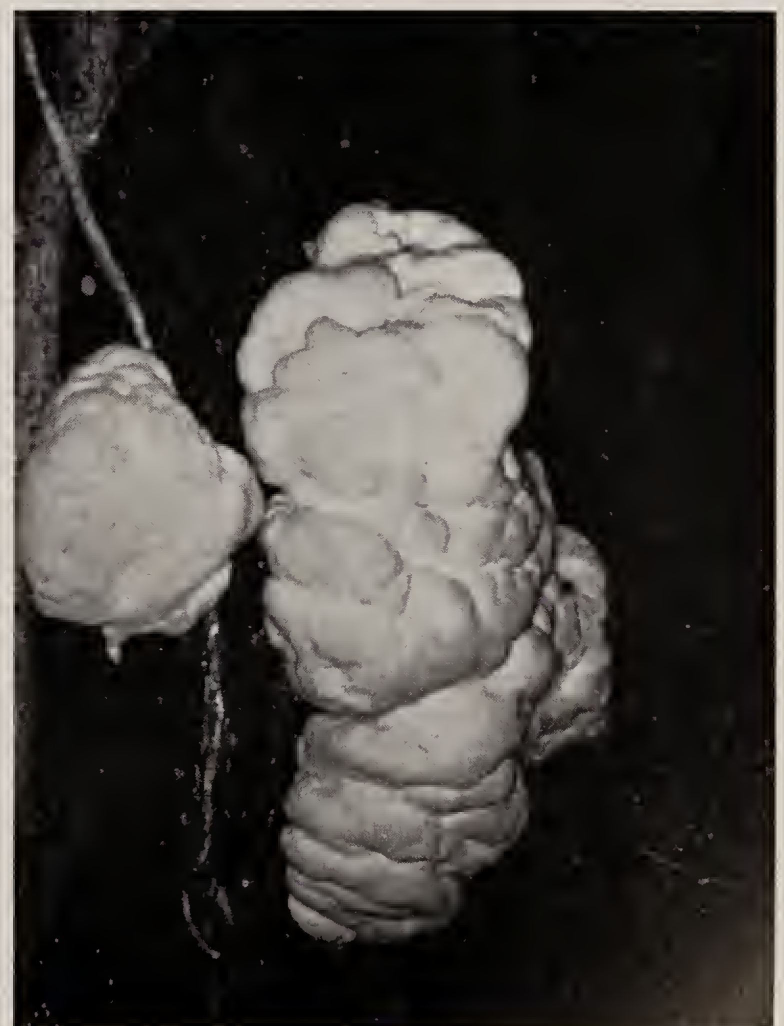

Fig. 48. Young *Polyporus sulfureus*. The mass is about 10 inches long.

Fig. 49. *Polyporus frondosus.*

shelves is a layer of tiny tubes, whose openings are directed downward. These multitudinous pores give the genus its name. *Polyporus frondosus* is commonly called the Hen of the Woods. It may be that this name was given because of a fancied resemblance of the fruiting bodies to large gray hens crouching in the leaf litter around a massive oak, tupelo or elm. (Fig. 49) It is even possible that some one detected in it the flavor of chicken. In either event, it is an interesting species because of the regularity of its fruiting habits. If the log or tree substrate is large enough, the fungus may be relied upon to appear in large quantities for several years. This year was an especially good one. One tree yielded an estimated 40 pounds of young fruiting masses, enough to satisfy the cravings of every known mycophagist on the staff, and still leave some for classroom study.

The second polypore, *P. sulfureus,* is known as the Sulfur Mushroom because of its color. It is regrettable that Figure 50 cannot show this. The undersides of the shelves are bright yellow; the tops, rich salmon. It grows on stumps and living trees, as does *P. frondosus,* but the fruiting bodies frequently form very high above the ground. A ladder and luck are needed to harvest the heavy clusters that grow from a tall black locust in the Botany Garden on the campus. When the fruiting body is young, the flesh is nothing like that of the corky, tough mature mass. As food, it is despised by some collectors, but others claim to relish the tender young stage. Perhaps the substrate induces variations in flavor, for *P. sulfureus* causes a red-brown heartrot of trees of a large number of genera. This detrimental activity, together with the beauty and delectability of the fruiting body are enough to make the species noteworthy, but mention should be made of the fact that it was once claimed that the fruiting bodies glowed in the dark! This has never been corroborated, not even by the late Dr. Buller who probably examined more fungi for this characteristic than any other person so far this century. There are a score of fungi that *are* luminescent, however, and some of them "fruited" in great profusion this fall.

Bioluminescence

Most of the organisms that are luminescent live in marine habitats, and some, certain tiny dinoflagellates, can set the seascape aglow in their abundance. Among terrestrial forms there are numerous bacteria, worms and, of course, the fireflies. Some organisms glow because of the bacteria living in or on them. Others secrete luminescent compounds into their environment. The light that is generated by others, however, is released only by shining from the cell interior. Before the age of electricity, many more non-scientists must have been conscious of this weird natural source of light. Not only were their surroundings more dimly lit, but lack of refrigera-

Fig. 50. *Polyporus sulfureus.* Picture taken 3 days after Fig. 48.

Fig. 51. *Clitocybe illudens.*

tion allowed luminescent bacteria to grow on such substrates as fish and meat. Considering the fact that even laboratories were illuminated by candlelight, it is no wonder that natural luminescence intrigued the chemist Robert Boyle to the extent that he tried to learn something of its secrets and became the first, in 1667, to note the dependency of the phenomenon in glowing wood upon something in the air.

Much later, (1885-7) DuBois made water extracts of a luminous mollusc and demonstrated what he called the "luciferin-luciferase" reaction. At first such unheated extracts glowed in the dark, then the light gradually diminished. If a portion of a fresh extract were boiled, then cooled, it would not glow, but if some of the original unheated extract whose light had just gone out were added to the portion that had been boiled, the luminosity returned for a while. DuBois concluded that there was one compound, "luciferin", that was not destroyed by heat, and another, an enzyme, "luciferase," that was destroyed by heating. He suggested that the enzyme promoted the oxidation of luciferin and caused the emission of light. Thus, in the original extract the light went out only when all the luciferin was oxidized. If however, an additional amount of this substrate were supplied in the form of the heated and cooled extract, light once again appeared.

Thanks to continuing research on bacteria, dino-flagellates, crustaceans, millipedes, and fireflies, we now know that the luciferin of one organism is not necessarily the same as that of another. The same may be said for the enzyme luciferase. It is thought also that oxidation of a luciferin compound alone is not sufficient to emit light, but that in the process the oxidized luciferin molecule is brought to an excited state and that it is during the decay from this state that light is emitted. The process is exceedingly effective. *Visible* light can be generated when the luciferin from a small crustacean is so dilute that there is only one part in 10 billion parts of water. The luciferase from the same animal can cause visible light emission from luciferin when it is present in a concentration of one part in 1000 billion parts of water. In the firefly, the light energy yield has been reported as approximately 1 quantum per luciferin molecule.

In certain organisms additional compounds are involved in the process. Furthermore, it is now known that some species are not dependent upon molecular oxygen for light emission, and, indeed, that certain luminescent organisms do not give a positive "luciferin-luciferase" reaction at all. Among the latter are the luminescent fungi. If such a system exists in the fungi, it must be under extremely delicate control within the cells. Buller, for instance, studied a ubiquitous fungus, *Panus stipticus.* The variety that grows in North America is luminescent, but its counterpart in Europe is not. This is a rugged fungus. Its small fruiting bodies commonly form in the fall and are subject to repeated desiccation, yet when remoistened, spore production is renewed, and, more interesting, the luminescent quality, lost in drying, is restored. (The writer has just returned from the darkroom to check the luminescence of some specimens that had earlier been remoistened after having been dry for a month. The usual wait of about ten minutes was necessary to get accustomed to the darkness, then the steady bluish glow was observed!) It was from this relatively indestructible fungus that Buller attempted to obtain a luminescent

Fig. 52. *Clitocybe illudens.* Part of the clump pictured in Fig. 51 photographed by electric light. Distance to camera 16 inches.

Fig. 53. *Clitocybe illudens.* Same as Fig. 52 but photographed by its own light. Exposure 2 hrs; film ASA 3000.

extract. Yet, before his very eyes, the gentle light was extinguished as moist fruiting bodies were squeezed between glass plates.

CLITOCYBE ILLUDENS

Clitocybe illudens, like *Panus,* resembles the grocery store mushroom more closely than do *P. frondosus* and *P. sulfureus,* since the caps have central stems and bear gills, rather than tubes, on their under surfaces. *C. illudens* is far handsomer however. The large fruiting bodies are bright yellow-orange, and grow in splendid clusters on roots and stumps. These spots of color in the slanting illumination of autumn are indeed beautiful, but it may be this very beauty that indirectly leads to sickness among persons of European origin who like to gather and eat mushrooms. *C. illudens,* in color, and slightly in appearance, resembles one of the most delicious comestible wild mushrooms, *Cantharellus cibarius,* that is commonly collected for food in Europe. The sudden sight of the beautiful Clitocybe must cloud the preception, for in most respects the two species are quite different. *Clitocybe illudens* can cause extremely uncomfortable gastro-intestinal disturbances in certain individuals. It was such an unfortunate report that signalled the advent of the fruiting period of the fungus this fall. At Militia Hill, not far from the Arboretum, it was found in profusion (Fig. 51).

The common name of *C. illudens* is Jack-o-Lantern, and for a good reason. It is one of the most brilliantly luminescent mushrooms. It can be understood, then, that the first place the collection went was not the laboratory, but the darkroom. Thanks to the new Polaroid film with a speed of 3000, it was not too difficult to photograph the cluster of fruiting bodies by their own light, revealing clearly the gill structure (Figs. 52 and 53).

Portions of the stems of the mushroom were surface-sterilized, then planted on a sterile nutrient medium. The cultures of vegetative mycelium obtained were observed in the darkroom, and they too emit a bluish glow.

ARMILLARIA MELLEA

Armillaria mellea is another gilled mushroom, and another luminescent one. Whereas the fruiting body of *C. illudens* glows brilliantly, that of *A. mellea* does not; *C. illudens* may cause illness if eaten, *A. mellea* delight. Its common name is the Honey Mushroom, not because of its flavor but because of the color of the caps of some forms of this extremely variable species. In a good season, like this one past, the profusion of fruiting bodies is spectacular. Within an area approximately 15 by 20 feet where brush and logs had been cast grew hundreds upon hundreds of mushrooms. (Fig. 54). The splendor of the sight was diminished by the thought that the trees from which the logs came may have died because of the parasitic activities of this mushroom.

Another name for *A. mellea* is the Shoestring Fungus. The vegetative stage forms thick dark strands resembling shoestrings beneath the bark of affected trees and logs. These rhizomorphs, as they are called, are luminescent, as are the hyphae buried in the wood. The luminescence is so bright that the wood itself seems to glow ("Foxfire"). It may very well have been such wood that Robert Boyle studied, for the species is widely distributed in the world. As a consequence, there are many tales of woodland lore

Fig. 54. *Armillaria mellea.* There are over 50 fruiting bodies in various developmental stages in this picture.

Fig. 55. Normal *Collybia dryophila.*

associated with it. It is said that its powers of illumination may be utilized in marking trails that can be followed in the dark. One recent visitor to the Arboretum recalled camping escapades of his youth, claiming that those boys who hung glowing wood in their tents received more mosquito bites than those who did not! Not a little consternation was caused among modern troops who first witnessed the eery light in woodland camp sites.

Occasionally *A. mellea* forms distorted fruiting bodies that bear little resemblance to normal ones.

COLLYBIA DRYOPHILA

Collybia dryophila is included among our fall quintet, not because it glows, not because it causes sickness of plants or people, but because, as mentioned for *A. mellea,* it can be its own worst enemy. A large collection was made at the Arboretum this fall that included all gradations in severity of distortion (Figs. 55 and 56). A few of the fruiting bodies were normal. Others bore small nodules of pale tissue on the caps, gill edges, or stems. Still others were so tumorous that none of the normal parts of a mushroom could be distinguished. Instead there was mass of contorted whitish flesh connected to the abundant mycelium in the compost substrate. One interesting thing about these masses is that a seemingly normal layer of spore-bearing cells covers them. This led early investigators to believe that another fungus was parasitic upon the Collybia. Now the consensus seems to be that this species of Collybia like certain others, including *Armillaria mellea,* is sometimes unable to differentiate properly. The cause is unknown.

As with *Clitocybe illudens,* cultures were made from this collection of fungi. Spores were allowed to fall from an apparently normal cap onto a sterile culture medium. They germinated, yielding a fungal colony from which subcultures were obtained. A small tumor was surface-sterilized and planted on a similar medium. Subcultures of the resulting colony were also made. To date, although extensive growth has occurred, nothing has been observed that clearly distinguishes the fungal tissue originally obtained from a healthy fruiting body from that obtained from a tumorour mass.

Interesting as the five fungi are in our present state of knowledge, it is clear that there is much opportunity for further investigation.

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Fig. 56. Large tumorous mass with tumor-bearing fruiting bodies of *Collybia dryophila.*

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* Gift of Edgar T. Wherry.

Juvenile Variation In Five Red Oak Species

Ernest J. Schreiner and Frank S. Santamour, Jr.[1]

The Michaux Quercetum study is a joint project of the Morris Arboretum of the University of Pennsylvania and the Northeastern Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, financed in part by the Michaux Fund of the American Philosophical Society. One of the objectives of this project, as outlined by Schramm and Schreiner (1954), is to provide information on the variation within oak species.

This is a report on the juvenile variation in five red oak species: *Quercus marilandica* Muench., *Q. rubra* L., *Q. velutina* Lam., *Q. coccinea* Muench., and *Q. falcata* Michx. The observations cover germination, 1 year of growth in the seedbed, and 2 years in a transplant nursery at the Morris Arboretum in Philadelphia, Pennsylvania. Previous publications on the Quercetum study and pertinent information regarding collection, planting, measurement, and analysis of the nursery phase are included in a recent report by Santamour and Schreiner (1961) on juvenile variation in five white oak species. This introductory material is not repeated here since it is presumed that readers of this report would also have access to the paper on white oak.

Discussion of Results

QUERCUS MARILANDICA

Blackjack oak was one of the most variable species tested in the Quercetum study (Table 1).

Germination. The two New Jersey seedlots differed significantly from all the others in germination rate. Average date of initial germination for the New Jersey lots was May 16, as compared to May 4 for the lots from the other four localities; by June 1 germination of the New Jersey lots was only 43 percent completed, as compared to an average of 87 percent for the others. The similarity in performance of the seedlots from Kansas to Texas does not support either clinal or racial variation. The variation shown by the New Jersey seedlots cannot be definitely characterized; it may represent local ecotypic variation.

Height Growth. The differences among individual seedlots in 1-year height was highly significant and, even with statistical limitations imposed by the loss of two plots in the third year, 3-year height showed significant differences. Differences in 1-year height also were highly significant among localities. Application of the Studentized range test (Keuls, 1952) resulted in two distinct groups: Arkansas-Texas and New Jersey-Kansas-Illinois. There is some indication of a trend toward better height growth from north to south.

Autumn Coloration. Only seedlot MQ-057 (Fig. 57) from Kansas proved to be significantly different from the average in fall color. The heavy mortality in the New Jersey seedlots during the second growing season may have obscured their true performance. If the New Jersey progenies are discounted, there is a semblance of a trend toward earlier coloration in the northern than in the southern progenies.

Survival. Survival of blackjack oak after transplanting was among the lowest for northern species: 77 percent as against, for example, 97 percent for *Q. rubra* planted the same year. Although there was considerable variation in first-year survival among the blackjack oak seedlots, the differences were not significant. The transplanting *per se* apparently was not the major cause of the mortality, since the progenies that suffered most continued to decline at an accelerated rate during the next 2 years. At the end of three growing seasons survival ranged from 2.4 to 58.3 percent and the differences among seedlots then were highly significant. Application of the Studentized range test gave the grouping shown in the following tabulation.

Survival of Q. marilandica progenies after 3 growing seasons[1]

Seedlot MQ-	State	Survival: Transformed values	Survival: Actual percentages
016	Texas	50.1	58.3
299	Arkansas	47.3	51.3
057	Kansas	46.6	52.9
227	New Jersey	26.7	21.4
421	Illinois	21.0	11.5
051	Kansas	15.0	10.4
222	New Jersey	7.9	2.4

[1]Values within brackets do not differ significantly.

[1] Geneticist-in-charge and geneticist, respectively, Northeastern Forest Experiment Station, U. S. Forest Service. The forest genetics research is in cooperation with the Morris Arboretum of the University of Pennsylvania.

TABLE 1.—DATA ON QUERCUS MARILANDICA AND Q. RUBRA

State	County	Elev.	Growing season	Seedlot number	Germination[1]		Average height 1-year		Average height 3-year		Autumn color ratings[2] 1		2		3	
		Feet	Days	MQ–	Percent		Centimeters		Centimeters		Percent		Percent		Percent	
					QUERCUS MARILANDICA											
1953 Fall sowing					6/1/54											
New Jersey	Ocean	6	179	222	35		4.3		14.2		0		100		0	
	»	10	»	227	48	43[3]	8.2	6.3	21.9	18.1	14	11	57	68	29	28
Kansas	Pottawatomie	984	183	051	94		7.7		20.6		12		24		64	
	»	1100	»	057	85	89	13.2	10.5	25.1	22.9	9	9	19	20	72	71
Illinois	Pope	——	192	421		96		10.1		28.4		0		45		55
Arkansas	Ashley	180	227	299		83		19.7		41.1		31		49		20
Texas	Harrison	200	240	016		85		23.8		43.5		23		61		16
					QUERCUS RUBRA											
1953 Fall sowing					6/1/54											
New Hampshire	Hillsboro	795	131	017	96		29.6		87.7		0		15		85	
	»	560	»	018	90		24.5		102.1		1		38		61	
	»	580	»	019	100	96	19.1	23.8	71.0	84.3	0	1	18	25	82	74
	»	812	»	020	98		21.5		76.5		0		24		76	
New Jersey	Somerset	——	165	221	100		21.8		70.4		0		33		67	
	»	——	»	228	100	100	19.0	20.4	66.8	68.6	0	0	54	50	46	50
Pennsylvania	Delaware	——	209	376	99		18.0		66.6		22		46		32	
	»	——	»	377	94	96	17.0	17.5	66.4	66.5	14	18	50	48	36	34
North Carolina	Haywood	4000	171	209	98		17.8		72.8		0		50		50	
	»	»	»	210	98	97	26.4	24.3	91.1	86.3	0	0	35	29	65	71
	»	4100	»	212	96		28.6		95.0		0		12		88	
Kansas	Pottawatomie	1015	183	052	91		15.8		55.2		0		12		88	
	Riley	1090	171	058	96	93	30.0	22.9	89.2	72.2	0	0	15	13	85	87
Illinois	Madison	——	178	416	89		26.4		97.3		1		30		69	
	Richland	——	185	418	100		28.4		82.4		0		12		88	
	Pope	——	192	426	98	96	19.1	24.6	54.1	75.7	10	4	43	26	47	70
	Hardin	520	192	471	100		24.6		68.9		1		21		78	
1954 Fall sowing					5/16/55											
Michigan	Clinton	600	158	365		100		21.5		86.6		0		50		50
Massachusetts	Worcester	840	153	176	94		11.1		50.5		3		9		88	
	»	»	»	177	88	92	11.8	11.5	64.6	57.6	10	7	18	14	72	79
Pennsylvania	Monroe	1900	127	542		75		26.4		49.4		0		50		50
Illinois	——	——	——	545		93		29.3		59.3		0		66		34
West Virginia	Tucker	——	145	557		100		15.5		56.4		6		26		68

[1]Percent of total germination on the dates indicated.

[2]1 = green; 2 = red-, orange-, or yellow-green; 3 = red, brown, or fallen. All seedlings were rated between November 4 and 11, 1955, when the 1953 seedlings were two years old and the 1954 seedlings were one year old.

[3]Figures opposite brackets are averages.

Although in general the southern seedlots had the highest survival, the significant differences between the two progenies from Kansas and between the two from New Jersey are as great as or greater than those between localities. Differences in survival between progenies of two trees from similar sites in the same locality probably represent individual variation.

Dr. Edgar T. Wherry (personal communication) has suggested that soil conditions may play a role in survival. Most oaks normally grow under fairly acid soil conditions, and it is possible that some species possess a differential capacity to survive in the circumneutral soil of the Quercetum nursery. Soil acidity may vary greatly within relatively short distances and seed collections from trees no more than a mile apart may be from quite different sites. However, differences in acidity of the soil supporting the parent trees do not explain the large differences in survival between either the two Kansas progenies or the two from New Jersey. According to information supplied by the seed collectors, the two New Jersey trees were only 45 paces apart and within 100 yards of a *Chamaecyparis* swamp on presumably acid soil; the two Kansas trees were within 500 feet of one another on a thin soil underlain by limestone.

TABLE 2.—DATA ON QUERCUS VELUTINA, Q. COCCINEA AND Q. FALCATA

State	County	Elev.	Growing season	Seedlot number	Germination[1]		Average height 1-year		Average height 3-year		Autumn color ratings[2] 1		Autumn color ratings[2] 2		Autumn color ratings[2] 3	
		Feet	Days	MQ–	Percent		Centimeters		Centimeters		Percent		Percent		Percent	
					QUERCUS VELUTINA											
1953 Fall sowing					6/1/54											
Minnesota	Goodhue	800	162	117	100		14.0		58.5		0		0		100	
	"	"	"	118	100	100[3]	14.0	14.0	60.8	59.7	0	0	0	0	100	100
Michigan	Clinton	900	158	366		100		13.8		46.1		3		13		84
Virginia	Montgomery	2100	168	107		97		13.9		48.2		3		46		51
Tennessee	Anderson	1200	186	233	98		14.8		51.9		7		52		41	
	"	"	"	234	99	98	19.0	16.9	57.1	54.5	3	5	36	44	61	51
Illinois	Johnson	——	187	379		94		13.6		39.2		6		19		75
	Cumberland	——	173	422	99		16.8		58.4		4		44		52	
	"	——	"	425	96	98	20.3	18.6	54.3	56.4	2	3	49	46	49	51
	Pulaski	——	200	428		99		18.8		47.0		3		29		68
North Carolina	Orange	450	210	372		91		20.1		52.0		4		45		51
Alabama	Jefferson	300	240	290	92		20.4		44.5		19		56		25	
	"	"	"	291	90	91	21.7	21.1	52.9	48.7	8	15	42	51	50	34
1954 Fall sowing					5/16/55											
Missouri	Dent	1320	182	472	94		9.2		29.7		15		38		47	
	"	"	"	473	85	90	9.0	9.1	26.5	28.1	7	11	36	37	57	52
Arkansas	Stone	980	215	264	100		10.1		33.6		0		18		82	
	"	"	"	266	97	98	9.0	9.6	35.0	34.8	0	0	29	25	71	75
					QUERCUS COCCINEA											
1953 Fall sowing					6/1/54											
Virginia	Montgomery	2100	168	108		100		12.2		42.0		4		36		60
Tennessee	Anderson	1050	186	231	99		13.6		37.1		1		35		64	
	"	"	"	232	98	98	16.1	14.9	43.3	40.2	5	3	22	28	73	69
Illinois	Hardin	520	192	469	90		22.4		48.2		7		43		50	
	"	"	"	470	98	96	15.6	19.0	42.7	45.5	7	7	38	39	55	54
Alabama	Jefferson	300	240	289	100		13.2		38.0		2		52		46	
	"	"	"	293	94	96	19.1	16.2	49.4	43.7	4	3	66	61	30	36
					QUERCUS FALCATA											
1954 Fall sowing					6/1/54											
Virginia	James City	——	205	409	26		11.4		37.1		48		39		13	
	York	90	"	410	43	36	14.9	14.1	33.8	37.6	18	30	73	64	9	6
	"	"	"	412	39		15.9		41.8		26		74		0	
Arkansas	Ashley	180	227	298		45		18.7		35.1		42		45		13
Alabama	Jefferson	300	240	292		24		10.6		33.3		51		38		11

[1]Percent of total germination on the dates indicated

[2]1 = green; 2 = red-, orange-, or yellow-green; 3 = red, brown, or fallen. All seedlings were rated between November 4 and 11, 1955, when the 1953 seedlings were two years old and the 1954 seedlings were one year old.

[3]Figures opposite brackets are averages.

Q. RUBRA

1953 Fall Sowing. The data for northern red oak are given in table 1. Although the entire range of this species was not sampled, the provenances represented vary considerably in latitude, elevation, and length of growing season. Nevertheless, seedling performances were quite uniform.

There were no significant differences among seedlots planted in 1953 in germination rate (average 96 percent), 1-year height (average 23 cm.), 3-year height (average 78 cm.), or survival after 3 growing seasons (average 88 percent). Although the variation in 1-year height growth closely approached significance, the tallest and shortest progenies were from adjacent counties in Kansas with similar elevations and lengths of growing season. There was a highly significant

Fig. 57. *Q. marilandica* (MQ-057) is only 2.5 feet tall, which is about the average for this species.

correlation between 1-year and 3-year height. With respect to growth, the data on these progenies indicate that individual variation is as important as racial variation.

The differences in autumn coloration between the Pennsylvania and the Pope County, Illinois, seedlots and the average of all seedlots were significant at the 1-percent level. Also, when localities were compared, the difference between the Pennsylvania seedlings and the average for all localities was highly significant. No significant correlation occurred between percent of seedlings in class 3 (leaves red, brown, or fallen) and length of growing season of the parent locality.

1954 Fall Sowing. There were no significant differences among seedlots in germination rate (average 94 percent). The low value for Pennsylvania seedlot MQ-542 is associated with poor total germination (4 percent).

Although the analysis of variance showed no significant differences among progenies in height growth at the end of the first growing season, the progeny from Illinois was markedly superior to the others. The lack of statistical significance was the result of two factors: poor germination in progenies MQ-365 (Michigan) and MQ-542 (Pennsylvania) which allowed the rapid growth of one or a few individuals to greatly alter the average, and a large difference between the replicates. Progenies in replicate I averaged 27 cm. in height, whereas those in replicate II averaged 12 cm. When the above-mentioned seedlots (MQ-365 and MQ-542) were removed from the analysis, the difference between the Massachusetts and Illinois progenies was significant.

To interpret the data on 3-year height, it must be noted that the replicates were maintained when the 1-year-old seedlings were transplanted; also, that all the seedlings were bitten off at or near the ground line by rabbits at the end of the second growing season. Thus, the 3-year height data on the 1954 progenies may reflect both inherent vigor and relative ability to recover by sprouting after injury.

The differences among progenies in 3-year height (after sprouting) were not significant even with MQ-365 and MQ-542 removed from the analysis. It is of interest, however, that there was no correlation between 1-year and 3-year heights. Moreover, relative progeny heights in the two replicates were reversed: seedlings in replicate I averaged 54 cm. in height, whereas those in replicate II averaged 68 cm. The reason for this reversal is not known. The lack of correlation between 1-year height and height after sprouting does not agree with observations made on *Q. alba* grown under the same conditions (Santamour and Schreiner, 1961).

Fall coloration of foliage developed more slowly in the Illinois progeny than in the orders. Chi-square tests showed a highly significant difference between coloring of the Illinois plants and the average of all progenies.

Q. VELUTINA

1953 Fall Sowing. The 13 seedlots of black oak sown in the fall of 1953 (table 2) were similar in their seedling performance. No significant differences appeared among seedlots in germination rate (average 96 percent), 1-year height (average 17 cm.), 3-year height (average 52 cm.), or survival after three growing seasons (average 78 percent). The correlation between 1-year and 3-year heights was decidedly nonsignificant. (Fig. 58)

Seedlots from Michigan and Alabama were significantly different from the average of all seedlots in fall color. Michigan seedlots had a larger percentage of seedlings with red or brown leaves and Alabama had more seedlings rated green or red-green. Also, the two Alabama progenies differed significantly from each other. When compared to the average, MQ-291 (with 50 percent class 3 leaves) was not significantly different, but the great difference exhibited by MQ-290 (with only 25 percent class 3 leaves) was sufficient to make the combined locality data significantly different. It is also obvious that the seedlots from Minnesota were different from the average, but the small number of seedlings

in these progenies did not allow statistical recognition of this fact.

There is some indication of a north-south trend in fall coloration; northern progenies tended to color earlier. Length of growing season in the locality of seed origin and percentage of seedlings with red or brown leaves was significantly correlated inversely, that is, long-season progenies had fewer red or brown leaves on any given date.

1954 Fall Sowing. Only two seedlots each from Arkansas and Missouri were sown in 1954. There were no significant differences among seedlots in germination rate (average 93 percent), 1-year height (average 9 cm.), or in height after sprouting in 1957 (average 31 cm.). Although no individual progeny differed significantly from the average of all progenies in fall color, a direct comparison between the two localities showed a highly significant difference. The retarded coloration of the Missouri progenies seemingly cannot be accounted for by climatic factors of the seed source; it may have been caused in part by their slightly later germination. We would again stress our opinion (Santamour and Schreiner, 1961) that fall color determinations on 1-year-old seedlings are of questionable value.

Fig. 58. *Q. velutina* (MQ-372) is now 10 feet tall and growing vigorously.

Fig. 59. *Q. falcata* (MQ-410) has developed this interesting, spreading form.

Q. COCCINEA

Data for the seven seedlots of scarlet oak planted in 1953 are presented in Table 2. There were no significant differences among progenies in germination rate (average 98 percent), 1-year height (average 16 cm.), 3-year height (average 43 cm.), or survival after 3 growing seasons (average 73 percent). There was a significant correlation between 1-year and 3-year height.

The difference in autumn coloration between the seedlots from Alabama and the average of all seedlots was highly significant. Alabama progenies had 64 percent of seedlings with green or red-green leaves while the other seedlots averaged 37 percent for these classes. The number of sources sampled is obviously inadequate to conclude that there is a north-south trend in this character.

Q. FALCATA

Although the range of *Q. falcata* extends as far north as Long Island, it is known as southern red oak. Lack of germination in several northern sources left only three seedlots from Virginia and one each from Arkansas and Alabama for comparison (Table 2). There were no significant differences among seedlots in germination rate (average 36 percent), 1-year height (average 14 cm.), 3-year height (average 36 cm.), fall color, or survival after three growing seasons (average 41 percent). No conclusions as to the extent and type of variation in this species can be made from this limited sample. (Fig. 59)

Summary and Conclusions

This report covers a study of the variation observed during three growing seasons among 7 single-tree progenies of *Q. marilandica*, 24 of *Q. rubra*, 17 of *Q. velutina*, 7 of *Q. coccinea*, and 5 of *Q. falcata*.

The variables considered in the progeny comparisons included earliness of germination, 1-year and 3-year height, autumn coloration, and survival at various ages. On the basis of these variables, and with due consideration of the exploratory nature of this study and the limited sampling of the species, the authors offer the following conclusions:

1. *Q. marilandica.* This species was extremely variable, but from the few seedlots tested it is impossible to reach any firm conclusions regarding the pattern of variation. There was a north-south trend in earliness of fall coloration, height growth, and possibly in 3-year survival. In survival, the difference between the progenies of the two parent trees from Kansas bridged the gap between northern and southern groups.

2. *Q. rubra and Q. velutina.* In the progenies of these species no pronounced tendencies were observed that would indicate racial variation, except that fall coloration in progenies from localities with longer growing seasons tended to be retarded. There was wide individual variation in the factors effecting growth.

3. *Q. coccinea and Q. falcata.* The few provenances of these species included in the study showed no evidence of racial or ecotypic variation. In *Q. coccinea* there was a highly significant difference in fall coloration between the Alabama progeny and the average of all seedlots, but the data are not sufficient to conclude that there is a north-south trend in his character.

4. The frequent, wide variations between progenies of two parent trees from the same locality emphasize the need for maintaining the identity of individual parent-tree progenies in provenance tests with these red oak species.

5. With the possible exception of *Q. marilandica,* individual tree selection appears to offer more promise than ecotypic or racial selection for genetic improvement of these red oak species.

Acknowledgments

The Michaux Quercetum has been a truly cooperative project since its inception. Personnel of the Morris Arboretum of the University of Pennsylvania, originally supervised by former director, J. R. Schramm, and now under the direction of John M. Fogg, Jr., have been responsible for nearly all the contacts with seed collectors and most of the nursery work. H. L. Li and Mary O. Milton have handled the accession records and herbarium specimens.

The measurement and evaluation phases of the project have been handled by the genetics personnel of the Northeastern Forest Experiment Station, U. S. Forest Service.

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Arboretum Activities

(*Continued from Page 50*)

New Board Member

At a meeting of the Advisory Board of Managers held on October 18, Dr. William C. Steere, Director of the New York Botanical Gardens, was elected to the Board to fill the vacancy created by the death of Mr. John B. Kelly.

A native of Michigan, Dr. Steere did his undergraduate and graduate work at the University of Michigan and taught there until 1950 when he was called to Stanford University. In 1955 he was appointed Dean of the Graduate Division at Stanford.

Dr. Steere's field work has taken him to Alaska, Mexico and South America. He has been Editor of the American Journal of Botany and Director of Systematic Biology of the National Science Foundation. On July 15, 1958, he assumed his duties as Director of the New York Botanical Garden.

Rhododendron Test Garden

The local chapter of the American Rhododendron Society, which holds its monthly meetings here, has recently created a Test Garden Committee with Mr. F. J. Sholomskas as Chairman. This committee is empowered to develop and maintain a Rhododendron Test Garden at the Morris Arboretum.

The Arboretum will make available a piece of ground which was formerly used as a holly and azalea nursery and the committee will prepare the soil, select and plant the Rhododendrons, and spray and fertilize the collections. We hope to publish a full account of this project in a future number of the Bulletin.

Operaton Glasstop

One of the major problems besetting an institution such as ours is the maintenance of the older buildings. Several years ago our very competent builder, Mr. Thomas J. Carney, saved the tropical fern house from oblivion by installing a totally new roof. This summer he performed a similar service for our Number 2 Greenhouse, the roof of which was in a state of serious disrepair to the point of being dangerous.

If one wishes to live dangerously he should remove the roof of his greenhouse in May and face the precarious task of installing a new one before the first killing frost of autumn. In this instance Tom made it with a few days to spare and all of the plants concerned are now safely under glass.

Fall Transplanting

Every December issue of this Bulletin carries an account of the routine autumn task of moving plants from lath-house, cold-frame and nursery to their permanent locations in the Arboretum. This fall the staff has been busier than ever before. First of all, the "tennis-court" nursery had to be vacated to accommodate the Rhododendron Test Garden mentioned above. In the second place, space in the cold-frames was desperately needed for new and younger material. Finally, there was our deep-seated desire to add to existing plantings and to create new ones. Most exciting among the latter has been the final selection of a site for the large and important Witch Hazel Family. Other family groupings which have been appreciably enriched are the Rosaceae, Leguminosae, and Aceraceae.

J. M. F., Jr.

Associates' Corner

The Arboretum's "Climatron"

In the preceding issue of the Bulletin I described my visit to the amazing new Climatron at the Missouri Botanical Garden. Back in Chestnut Hill, I began wondering whether the Morris Arboretum should ever attempt to emulate this achievement, when it suddenly occurred to me that we already had a climatron in miniature — namely the Tropical Fern House.

The Fern House was designed and constructed by Mr. Morris, himself, with his local labor, about 1894, with the objective of assembling as many species and varieties of tropical ferns and selaginellas as possible in the given space, — the whole area is not more than 1200 square feet.

To supply a natural habitat besides the required soils, different levels and variations of moisture were created with walks in between. There is a grotto, more of which anon, a stream feeding small pools with goldfish inhabitants, a rocky mound, under which is a tunnel, and a picturesque bridge over the stream. The walls are constructed of the local Wissahickon gneiss and the glass roof is quite original and ingenious. So much so, that when repairs were needed the several greenhouse firms approached either declined to attempt them or quoted a prohibitive price. These difficult repairs have been skillfully accomplished by our own Tom Carney.

The "sunken glass-topped house" as the Fern House has been called, is heated by pipes running around the walls completely covered by foliage, and aired by an automatic vent control The variations of levels, light and air exposure, and moisture according to the proximity of the little stream and pools, conform basically to the principles employed at the Missouri Climatron. And all this was conceived by one man back in the 1800's!

So much for the description of the building — now as to the contents. Literally every inch of space is occupied by tropical ferns and their cousins, the selaginellas which, over a period of years, have mingled to form a fairyland of delicate colors and textures. Even the water areas contain various species of the Floating or Water Fern, *Ceratopteris thalictroides.*

In the dark grotto which constantly drips moisture, the most interesting fern of all grows prolifically: the Killarney Fern, *Trichomones radicans.* It is one of the Filmy Ferns with fronds only a single cell-layer thick, which cannot stand the least drying out. This makes it extremely difficult to grow in cultivation, although in the wild, it is widely distributed in warm moist situations from Spain to Japan.

The English name "Killarney" derives from a clump growing amid spray drenched rocks by a waterfall in Killarney, Ireland. The grotto in our miniature climatron is completely lined with Killarney and this particular colony is probably the largest and best established of any bo-

tanical garden in the temperate zones. It is so famous that the Morris Arboretum is constantly receiving requests for living material from other gardens and Arboretums throughout the country. The little fern is not only tremendously interesting, but also very beautiful with its dark, wet, green leaves sparkling here and there with reflected light like scattered diamonds.

Everywhere one looks in this tropical world there is beauty and fascination, from Australian Tree Ferns to the tiny Maidenhairs only six inches high, while the walls are thickly covered by the Creeping Fig, *Ficus pumila,* giving one the impression of being in an impenetrable jungle.

I am so glad I went all the way to Missouri to discover what an exceptional treasure we have in our midst. If you have not been to the Tropical Fern House, give yourself a Christmas treat in a Dream World.

Marion W. Rivinus

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Errata

Page 16, line 9 (r.) for *granaiflora* read *grandiflora*
Page 18, line 19 (r.) for *Myrtaceae* read Myrtaceae
Page 25, line 38 (l.) for *ilicifolia* read *ilicifolius*
Page 27 Transpose Figs. 20 and 21
Page 39, line 22 (l.) for Ouercetum read Quercetum
Page 45, line 11 (r.) for *prinus* read *Prinus*
Page 45, line 32 (r.) for *prinus* read *Prinus*

Morris
ARBORETUM BULLETIN

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Juniperus chinensis sylvestris

Published by
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THE MORRIS ARBORETUM

The Morris Arboretum Bulletin is published quarterly at Philadelphia, Pa., by the Associates of the Morris Arboretum, Chestnut Hill, Philadelphia 18. Subscription, $1.50 for four issues. Single copies, 40 cents. Free to Associates.

THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

On Friday, January 26, the Director addressed the members of The Modern Club at a meeting held at Sweetbrier Mansion. The subject of his talk was "Early Botany in the Philadelphia Area." On March 1 he spoke to the Wayne Garden Club on "The New Jersey Pine Barrens" and on March 21 he gave an illustrated lecture on Magnolias at Longwood Gardens.

Early in January Dr. Li returned from Berkeley, California, where he had spent six months working on his Formosa flora. He is now putting the finishing touches on that effort, as well as teaching a course on the Morphology of Higher Plants in the Department of Botany.

On February 7 Dr. Allison spoke to the Bios Club of Swarthmore College on "Fungi in Nature and in the Laboratory."

Lectures in Ecology

In line with its policy of offering instruction in Botany and Horticulture, the Arboretum in early February sent out to more than 700 of its Associates notices of a course of lectures in Plant Ecology to be given during March by Dr. Edgar T. Wherry, Emeritus Professor of Botany at the University and long a member of the Arboretum staff. Although the size of the class was announc-

(*Continued on Page 19*)

Juniperus at the Morris Arboretum

Edith C. Gall

Introduction

The genus *Juniperus* contains some fifty species of trees and shrubs which are widely distributed throughout the northern hemisphere from arctic regions to the high altitudes of the tropics.

Although traditionally *Juniperus* has been placed in the Pinaceae or Pine Family, there has been a tendency in recent years to segregate from that family those genera in whch the leaves are opposite and usually scale-like rather than alternate or fascicled and needle-like. According to this arrangement *Juniperus* belongs to the Cupressaceae, or Cypress Family, together with *Cupresseus, Chamaecyparis, Libocedrus, Thuja,* and *Thujopsis.* From these genera *Juniperus* is sharply distinguished by having a fleshy berry-like, rather than a dry, cone-like, fruit. (Fig. 1). Also, unlike most other conifers, Junipers are generally dioecious, that is, the sexes occur on separate plants.

Junipers are grown for their ornamental value because they exhibit a wide variety of growth forms. Their habit varies greatly from pyramidal trees to low prostrate or trailing shrubs. Together with *Chamaecyparis,* they have two types of foliage, both juvenile, or needle-like leaves, and adult, or scale-like leaves. Single plants may have one or the other or both, as well as a variety of color forms. A few varieties may also be clones of the male or female plant only. Of the 50 species of *Juniperus* in the world, the Morris Arboretum has 13 species and approximately 50 varieties and cultivars.

Horticultural requirements

Junipers thrive best generally under sunny open conditions on sandy and loamy, moderately moist soil. They can be propagated from seed, layering or cuttings of ripened wood taken in the fall. The needle-type root more easily than the scale-like. Layering is recommended for shrubby species. In germinating seed, it is advisable to plunge the seeds for three to six seconds in boiling water, but it may be desirable in some cases to omit this treatment.

The Key

The following key is specially composed for the identification of the thirteen species which are found in the collection of the Morris Arboretum. The keys that are now in use generally employ fruit size, shape and color. These are not always available. Also, when dimorphic vegetative characters are shown, the keys alternate from one type to the other throughout the key, while varieties may exhibit only one type. Consequently in devising this key, I have tried to restrict myself solely to those characteristics that would be readily available for identification. An exception was made for growth habit, a character I was finally forced to employ to separate certain species. Also, I have constructed the key in such a manner that if only scale-like leaves were available, it could be followed, and conversely, if only needle-like leaves were present it, too, could also be utilized without the necessity of jumping from needle-like to scale-like and back again. I have eliminated any reference to odor which while generally an ideal field character, tends to lose its quality in dried material.

Fig. 1. *J. chinensis* in fruit

A. Leaves scale-like, all or in part.
 B. Leaves glandular.
  C. Habit, low-growing or prostrate.
   D. Leaves dark green. *J. Sabina*
   DD. Leaves bluish-green or steel blue. *J. horizontalis*
  CC. Habit, tree.
   D. Leaves incurved at apex, adpressed, clearly glandular.
    E. Leaves with gland near center.
     F. Gland in a depression. *J. chinensis*
     FF. Gland elevated. *J. excelsa*
    EE. Leaves with gland toward the base; gland elevated. *J. Ashei*
   DD. Leaves not incurved at apex, adpressed, obscurely glandular. *J. scopulorum*
 BB. Leaves eglandular.
  C. Leaves narrowly rhombic, closely appressed; fruit brown. *J. chinensis*
  CC. Leaves rhombic-ovate, free at apex; fruit blue-black, *J. virginiana*
AA. Leaves needle-like.
 B. Leaves jointed at the base, all needle-like, ternate; flowers axillary.
  C. Leaves with one white band above; mid-rib indistinct.
   D. Leaves shallowly grooved. *J. communis*
   DD. Leaves deeply grooved.
    E. Branchlets triangular. *J. rigida*
    EE. Branchlets terete. *J. conferta*
  CC. Leaves with two white bands above, converging at apex; mid-rib fairly distinct. *J. formosana*
 BB. Leaves not jointed at the base, both needle-like, and/or scale-like or all needle-like, ternate or binate; flowers terminal.
  C. Leaves all needle-like and ternate.
   D. Growth prostrate.
    E. Leaves green beneath; branchlets green. *J. squamata*
    EE. Leaves glaucous beneath; branchlets glaucous. *J. procumbens*
   DD. Growth erect. *J. excelsa stricta*
  CC. Leaves both needle-like and/or scale-like, ternate or binate on leading shoots.
   D. Leaves minutely serrulate, (with magnification). *J. Ashei*
   DD. Leaves entire.
    E. Leaves always binate.
     F. Needle-like leaves few, 3 mm long, not deeply grooved; habit prostrate. *J. horizontalis*
     FF. Needle-like leaves many, 9 mm. long, deeply grooved; habit upright. *J. scopulorum*
    EE. Leaves binate and/or ternate.
     F. Leaves with more than one white band.
      G. Branchlets four-angled. *J. excelsa*
      GG. Branchlets not four-angled. *J. chinensis*
     FF. Leaves with one white band.
      G. Habit prostrate. *J. Sabina*
      G. Habit upright *J. virginiana*

Junipers at the Arboretum

There follows a brief characterization of the species, varieties and cultivars of *Juniperus* which, over a period of many years, have proved hardy at the Arboretum. The Morrises were keenly interested in this genus and assembled a wide variety of growth and color forms. Most of these are to be found along Hillcrest Avenue west of the Lodge.

During the 1930's the collection was augmented by the gift of several specimens from Cos Cob on Long Island. Additions were later received from the New York Botanical Garden.

In the descriptions which follow the leaves of the juvenile growth may be designated as "needle-like", "awl-shaped", "acicular," or "linear". The differences separating these shapes are of a minor order, but all of them are in marked contrast to the "scale-like" leaves of the adult foliage. When the leaves are needle-like they may be arranged in two's (binate) or in three's (ternate).

Fig. 2. *J. chinensis alba*

Fig. 3. *J. chinensis* 'Bleak House'

Authorities for the botanical names are given whenever known. A few, however, have eluded an exhaustive search and a few others are designated simply as "Hort", indicating a horticultural form of unknown or uncertain origin.

JUNIPERUS ASHEI

J. Ashei Buchh. (*J. mexicana* Schlecht.) A shrubby tree, native to southern Missouri and Arkansas, with binate and ternate needle-like leaves, angular branchlets and gray shreddy bark. Infrequently found in cultivation.

JUNIPERUS CHINENSIS

J. chinensis L. Chinese Juniper. An extremely variable species which extends from the Himalayas across China to Japan. It may be a tree or a procumbent shrub; its leaves may be scale-like or needle-like and it may also produce dissimilar male and female forms.

J. chinensis alba (Gordon) Rehder (*J. japonica* Standish, *J. chinensis procumbens albo-variegata* Beiss.) a low growing form with the tips of the branchlets very white, especially in the winter. (Fig. 2)

J. chinensis aurea Young. Although slow-growing at first, this variety can, in time, become quite large. The young foliage is a brilliant yellow, especially when grown in the full sun. This is a male form which bears both juvenile and adult leaves.

J. chinensis aureo-globosa Nash. A dwarf globose form, the young branchlets of which have a gold yellow color.

J. chinensis 'Bleak House'. Our fine specimen of this, which was obtained from Cos Cob in 1935, is now about twelve feet tall. It is one of the rarest junipers in our collection, seldom being found on plant lists. The acicular leaves are usually ternate and the scale-like leaves which are distinctly in the minority are eglandular. (Fig. 3)

J. chinensis columnaris Krüssman. A very hardy, narrow-pyramidal form with silver-green awl-shaped leaves.

J. chinensis 'Excelsior'. A columnar tree, up to twenty-five feet, in which the binate or ternate acicular leaves predominate over the few glandular scale-like ones. The glaucous fruit are 5-8 mm. in diameter.

J. chinensis Fortunei. Hort. According to Bailey (1933), this is a plant with many trunks bearing mostly bright green awl-shaped leaves. Our specimen is a tree, about twenty-five feet tall, with a beautiful graceful, open habit and a predominance of scale-like leaves.

J. chinensis globosa Nash. An extremely slow-growing form with crowded thickish branchlets bearing bright green scale-like leaves. A few of the lower branchlets may produce awl-shaped leaves.

Fig. 4. *J. chinensis Pfitzeriana*

Fig. 5. *J. chinensis pyramidalis*

J. chinensis Hetzii Hort. A shrub up to ten feet with gray or bluish-green scale-like leaves. The fruit is small and glaucous.

J. chinensis japonica (Carrière) Lavallée. A low shrub with decumbent branches, making a fine gound cover. It has a fresh green color and its leaves are usually acicular and ternate.

J. chinensis 'Kaizuka' Hort. Although seldom listed, this is doubtless the form referred to in Hortus Second (1941) as 'Kaizuda'. It is a beautiful compact tree up to ten or twelve feet with bright green scale-like leaves. Our specimen is one of those received from the Cos Cob collection in 1935.

J. chinensis mas (L.) Gordon. As the name implies, this is a male clone. It is a dense conical or columnar tree with green or slightly bluish awl-shaped leaves.

J. chinensis oblonga Hort. A tree, up to fifteen feet, with bright green needle-like leaves predominating. The tips of the branchlets are somewhat reflexed and some of them bear short, fine, scale-like leaves. The variety conveys the same impression as *Chamaecyparis pisifera squarrosa cyano-viridis,* except that the juniper differs in its harsher foliage. This is another of the fine specimens which the Arboretum received from Cos Cob in 1935.

J. chinensis pendula Franch. The branches and branchlets have a loose, open arrangement with pendulous tips bearing dark green scale-like leaves. Bright green acicular leaves occur occasionally.

J. chinensis Pfitzeriana Spaeth. Pfitzer's Juniper. Although slow-growing, this variety is capable of producing a broad pyramidal plant about twelve feet tall with an open, ascending habit. The grayish-green leaves may be either scale-like or needle-like and, when the latter, either binate or ternate. (Fig. 4)

J. chinensis Pfitzeriana argentea Hort. A form with silvery-green foliage. Although other listings of this plant are noted in Plant Buyers' Guide, our plant came from a sport detected at the Ambler Nursery.

J. chinensis Pfitzeriana glauca Hort. A color form of Pfitzer's Juniper with glaucous leaves.

J. chinensis prostrata. A shrub up to three feet with horizontal branches predominating. The foliage is mostly scale-like with a few opposite awl-shaped leaves on the older wood.

Fig. 6. *J. chinensis variegata*

Fig. 7. *J. communis depressa*

J. chinensis pyramidalis (Carrière) Beissner. A plant having a narrow, pyramidal form with blue-green foliage. The leaves which are predominantly awl-shaped and ternate have two white bands. (Fig. 5)

J. chinensis Sargentii Henry. This handsome variety makes a fine ground cover, forming dense procumbent mats. Adult plants have mostly bluish-green, scale-like leaves, while younger individuals bear acicular leaves of a grass-green color.

J. chinensis Sheppardii Hort. in Veitch. The juvenile awl-shaped leaves of a glaucous blue-green color predominate on this plant of a drooping, bushy habit.

J. chinensis Smithii Loudon. A plant of pyramidal form with pendulous terminal branchlets and scale-like leaves.

J. chinensis sylvestris Hort. Our plant, which came from Cos Cob, is now an open tree about fifteen feet tall (see cover). The foliage is entirely acicular and the very spiny, ternate leaves are bright green in color with two broad white bands above.

J. chinensis variegata Gordon. A compact shrub showing a creamy white color on the tips of the branchlets. Both juvenile and adult foliage are present. (Fig. 6)

J. chinensis viridifolia. This is a tree up to fifteen or twenty feet, with bright green juvenile leaves, which we received from A. S. Walton, Newark, Delaware, in 1946. No further authoritative identification of it has been made.

JUNIPERUS COMMUNIS

J. communis L. Common Juniper. This is a circumboreal species of varying habit which ranges across North America, Europe and Asia at high latitudes with southern extensions usually along the mountains or uplands. The needle-like leaves are concave above with broad white bands that may divide toward the base of the leaf which is usually bluntly keeled beneath. Although usually trailing or procumbent, this species may, in the southern portions of its range become a low tree of conical or columnar form.

J. communis aurea Nicholson. A form in which the younger foliage is golden yellow, but turns green the second year.

J. communis depressa Pursh. This is the common low juniper of eastern North America which forms broad patches with branches ascending from a decumbent base. It is green in color. (Fig. 7)

J. communis hibernica (Loddiges) Gordon. Commonly called 'Irish Juniper', this plant has a columnar form up to twelve feet. The tips of the branchlets are erect and the dark green leaves are usually shorter and less spreading than in the foregoing variety.

J. communis 'Hornibrook'. A prostrate juniper with ternate, acicular leaves that have a wide, white band on the upper surface. The ridged

Fig. 8. *J. formosana*

Fig. 9. *J. scopulorum* 'Moonlight'

branchlets are green, turning red. This is another plant which the Arboretum received from Cos Cob.

J. communis saxatilis Pallas. (*J. nana* Willd., *J. sibirica* Burgsd.) This is the wide ranging juniper of arctic and mountainous regions from Greenland to Alaska, occuring also at high latitudes in Eurasia. It is is a low trailing plant, seldom more than two feet tall, with short leaves and dense foliage.

J. communis suecica nana Hort. The dwarf Swedish Juniper, although slow growing, may attain a height of six feet, with a compact, conical habit.

JUNIPERUS CONFERTA

J. conferta Parl. Shore Juniper. This Japanese species is prostrate and trailing with crowded linear leaves that are a fresh green when young, becoming grayish green with age. The plant is recommended as a good ground cover, particularly in open sandy situations.

JUNIPERUS EXCELSA

J. excelsa Bieb. Greek Juniper. This upright or spreading species from southern Europe and southwestern Asia is represented at the Arboretum by the following varieties:

J. excelsa stricta Gordon. A slow-growing columnar form, up to six feet, with glaucous juvenile foliage.

J. excelsa variegata Hort. Differs from the preceding in its yellowish-white leaves.

JUNIPERUS FORMOSANA

J. formosana Hayata. Formosan Juniper. A handsome tree, up to thirty feet, usually dividing into several stems at the base. The branches are ascending with spreading or pendulous branches and the linear, spiny-pointed leaves are about one inch long (Fig. 8)

JUNIPERUS HORIZONTALIS

J. horizontalis Moench. Creeping Juniper. This procumbent or trailing shrub is native to northern North America. It is a valuable ground cover with creeping branches and numerous short branchlets. The foliage, in which scale-like predominate over needle-like leaves, is bluish-green or steel-blue.

J. horizontalis alpina (Loud.) Rehder. The young growth is mostly upright, but the plant becomes procumbent with age.

J. horizontalis 'Bar Harbor' Hort. A color form in which the foliage is steel-blue. The plant is capable of forming dense mats.

J. horizontalis Douglasii Rehder. Waukegan Juniper. A trailing plant in which the leaves are bluish-green in summer, turning purplish in winter.

J. horizontalis plumosa Rehder. Andorra Juniper. This juniper in which the linear leaves are grayish-green at first, turning purplish in the fall, is a creeping form with feathery branchlets.

JUNIPERUS PROCUMBENS

J. procumbens (Endl.) Sieb. and Zucc. Probably the most famous prostrate juniper to come from Japan, this handsome plant has wide-spreading stems and bluish-green foliage. The sharply-pointed acicular leaves are concave above and on the under side have two glaucous lines that run to the edges of the pulvini.

JUNIPERUS RIGIDA

J. rigida Sieb. and Zucc. Needle Juniper. A tree or tall shrub with graceful loose branches

and pendulous branchlets. The slender, spreading, spiny-pointed linear leaves may be 2.5 cm. long.

JUNIPERUS SABINA

J. Sabina L. Savin. A procumbent dark green shrub from the Caucasus. The leaves may be needle-shaped or scale-like with a gland on the back. The slender branchlets produce a disagreeable odor when bruised.

J. Sabina tamariscifolia Ait. A low spreading shrub with ternate acicular leaves which have one bright band above. The branches are deeply grooved. The color of the foliage varies from bright green to bluish green.

JUNIPERUS SCOPULORUM

J. scopulorum Sarg. Western Red Cedar. This species, native to the Rocky Mountains, is represented at the Arboretum by the two following cultivars.

J. scopulorum 'Moonlight' Hort. A shrub to about eight feet. The silvery, opposite, acicular, entire leaves are deeply grooved with one white band on the upper surface. (Fig. 9)

J. scopulorum 'Blue Moon' Hort. A tree to fifteen feet with gray-green scale-like leaves which are occasionally glandular. The glaucous fruit are 3 mm. across.

Fig. 10. *J. virginiana globosa*

JUNIPERUS SQUAMATA

J. squamata Buck-Ham ex Lamb. Himalayan Juniper. A decumbent shrub, sometimes with ascending branchlets. The leaves are linear, crowded, and loosely appressed, grooved, grayish- or bluish-green, with two white bands above. This species has a wide distribution with various geographical forms.

J. squamata Meyeri Rehder. Meyer's Juniper is an upright shrub with many short straight branches giving it a dense appearance, which may later become shaggy. The acicular leaves are very glaucous on the back.

JUNIPERUS VIRGINIANA

J. virginiana L. Red Cedar. The common Red Cedar of eastern North America is a pyramidal or globose tree which may attain a height of sixty feet or more. It becomes a slow grower after about fifteen feet and tends to lose its symmetry, becoming quite picturesque. Both juvenile and adult leaves may be present and the foliage varies from grayish to bluish-green.

J. virginiana Burkii Hort. A narrow pyramidal tree to fifteen feet with silver-gray foliage.

J. virginiana compacta Hort. A dwarf globose form about two and a half feet tall, with bright green scale-like leaves.

J. virginiana pyramidalis (Carrière) Beissner. pyramidal tree with the tips of the branchlets a golden yellow.

J. virginiana glauca Hort. ex Carrière. A narrow columnar tree up to twenty-five feet, silver-blue scale-like leaves that darken as the season progresses.

J. virginiana globosa (Beissner) Schneider. A densely globular form growing to a height of four feet, with bright green scale-like foliage. (Fig. 10)

J. virginiana Keteleeri Hort. A compact pyramidal form with ascending branches on which bright green scale-like leaves predominate.

J. virginiana pyramidalis (Carrière) Beissner. A dense columnar form with both types of foliage; the scale-like leaves predominate, but some acicular leaves bearing one broad white band occur.

J. virginiana pyramidalis glauca Hort. Similar to the preceding, but with glaucous foliage.

J. virginiana pyramidiformis cv. This tree which we received from the New York Botanical Garden as *J. rigida columnaris,* is definitely not *J. rigida* since it does not have jointed leaf bases. It exhibits a very delicate appearance which is unusual in junipers. The binate, needle-like leaves are only about 5 mm. in length and turn purple in autumn.

J. virginiana Schottii C. de Vos. A narrow pyramidal tree to twenty feet with bright green scale-like leaves.

J. virginiana tripartita (Sénécl.) Beissner. A dwarf shrub to five feet with ascending branches and drooping tips. The base of the plant is usually divided. The acicular leaves are glaucous or bluish-green.

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New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since December, 1961:

Mr. Kenneth Arnold

Mrs. James F. Bodine

Mrs. Ruth B. Bowers

Mr. Robert A. Bradel

Chestnut Hill Academy

Mrs. James C. Curnow

Mrs. Alex J. Duckett

Mrs. Robert M. Fisher

Mrs. E. Dyson Herting

Mrs. R. L. Hill, Jr.

Mrs. Raymond W. Huss

Mrs. G. Clinton Jones, IV

Mrs. E. A. Kaier

Mr. and Mrs. William M. Lee

Mrs. Edward B. Leisenring

Mr. Harold G. Nilson, Jr.

Miss Mary E. O'Neill

Dr. and Mrs. John S. Penny

Mrs. E. Pfeifer

Mrs. H. Rudolph Pott

Mrs. Charles Reese

Mrs. Hillary Robinette

Mrs. Howard Shaw

Mrs. Roy F. Spreter

Mr. and Mrs. Donald Stern

Mr. Dean R. Thompson

Mrs. Russell H. Trenholme

Mr. William H. Walter

Mrs. James B. Woodford

Botany and Poetry

Hui-Lin Li

In his book, *Education at the Crossroads,* J. Maritain recommended that "Physics should be taught and revered as a liberal art of the first rank, like poetry." We may add that what is good for physics is good for other natural sciences, including botany. In this world of specialization, there is a steady tendency, especially in teaching, to divorce the sciences and the humanities. Nevertheless, the sciences are in many ways also humanistic, since they are closely related to the world of men as well as to their ideas. Science is not only for men to "conquer" Nature, but also for the sake of men to live with one another.

"Science and poetry" and "scientists and poets" are profound and fascinating subjects for the occasional discussions of some inquisitive minds. This short note, however, is not a philsophical discourse on these subjects. It is merely the record of an anecdote in which poetry and botany were mutually involved, with the end result that both were somewhat enriched, though perhaps only to a very small degree. Although plants, trees, flowers, etc. are in general popular subjects for poems in all languages, botany, the science of plant study, is rarely, if ever, concerned with poetry. Here is an example in which it is.

Our story concerns some of the conifers in eastern Asia. Eastern Asia is exceedingly rich in the number of genera and species of conifers. In the course of extensive botanical explorations carried on over the last hundred years, numerous interesting forms, many of them relict and rare occurrences, have been discovered in that part of the world. Eastern Asia possesses no less than fifteen endemic genera of conifers, genera that are not found in any other region of the world. Among these are such well known genera as *Cryptomeria, Cunninghamia, Cephalotaxus, Pseudolarix, Thujopsis, Sciadopitys* and *Metasequoia,* choice ornamental plants now widely cultivated all over the world. *Metasequoia* was not discovered until 1941. Even as late as 1958, another new genus, *Cathaya,* was discovered from southwestern China. The total of endemic species may be numbered in the hundreds.

Among the many discoveries, perhaps the most interesting case is the one described here. The story was told by Bunzo Hayata, a professor of botany at Tokyo University in Japan in 1917 in a paper entitled "Some conifers from Tonkin and Yunnan," in *The Botanical Magazine* of Tokyo, volume 31, pages 113 to 119. 1917.

It all began with the delightful pastime of reading Chinese poetry for enjoyment by many Japanese scholars of the older generations. It should be mentioned that Chinese poetry, as many Orientalists can attest, is a most exquisite form of literature. Its beauty, however, as is true of poetry in general, cannot be successfully translated into other languages and thus has to be appreciated only in its original. Japanese scholars of the older generations all read Chinese, as the Japanese actually borrowed their written language from the Chinese in early times.

Sometime before 1917, Shitaro Kawai, a professor of forestry in Tokyo University, was attracted to a Chinese poem "Shu-hai Ko" or "Song of the Sea of Forests" by a famous Chinese poet Chao Ou-pei, of the Ching dynasty. His poetry was well known among the scholars of Chinese in Japan around the early part of this century.

Chao was not only a famous poet but also a distinguished historian and an official in the imperial government of the Ching dynasty. He lived in the eighteenth century. Once, on an official mission to the southern Chinese border between Yunnan and Indo-China, he came across a vast stretch of primeval forests which so impressed him that he composed a poem to record this memorable sight for his friends back home in the more northern part of China. In the preface to his poem, it says "From Lower Lanchou to Kai-hua, Yunnan, wherever it borders along with Cochin China, for a length of 800 *li* there are huge forests, appearing from a distance like a sea; this song is composed to record this."

Professor Hayata translated the essential passages of the poem literally as follows:

> "Nothing can be more surprising than to see that there still exists a primeval forest, while the civilization has long since swept over nearly all of this country. When travelling through the mountains of Cochin China, I was greatly astonished to find an immense forest, stretching away like a broad ocean. The regions being very far from human dwellings, there was no trace of cultivation, nor could one see even the smoke from a woodcutter's hut. The ground in the region was rather poor, and

the growth seemed, therefore, to have been very slow. Yet, the trees in the forest were all very tall and large, giving one the impression that they were the growth of immeasurable ages. The leaves, stout as a dragon's mustaches (plainly denoting Conifer leaves) told how very severe the cold had been in winter, and the fallen pieces of bark over-lapping one another like a monster's scales showed how frequent were the thunderbolts in summer. The central shaft of a five-storied pagoda could be made of a single trunk from this forest, so tall and big were the trees generally. Yet, it was very regretable to see that owing to the remoteness of the region and the steepness of the mountains, it was impossible to carry them out for use. They had attained, therefore, to a very great age without being neither employed nor cut. Some that had died from very age, remained up-right as they were, turned to white skeletons, and stood side by side like an army of ghosts without mark of ruin or injury. And yonder the broad ocean of the darkgreen forest stretched away far to the horizon without a break. Neither valley nor ridge was visible, all being covered uniformly with one mass of green. At one time, perfect quiet reigned over all the place, but at another it was broken by winds which turned all the foliage on the mountains into tossing waves. I had already travelled throughout this country and found it everywhere cultivated. Never had I seen so wonderful a sight as this view of a primeval forest."

Hayata adds that "The description of the forest in the original poem is done with exquisite beauty, which however, certainly does not appear in my translation." He also notes that the "original is also very accurate" and that "it must have been done from the poet's sketches of nature made on the spot."

Apparently impressed by the vivid and accurate description, the poem attracted the immediate attention of Professor Kawai. He figured that such a forest must actually exist somewhere along the southern Chinese border. On the nature of the trees that constitute these forests, he believed that from the poet's description of the dead trees appearing as "white skeletons standing like an army of ghosts", these trees could only be some kind of conifers. Broad-leaved trees, as he noted, when dead, are nearly always covered by mosses or fungi and therefore would not appear as such. He further speculated that the forests must be formed by *Cupressus* and other conifers similar to those in Formosa, an island east of the mainland, whose flora was familiar to these Japanese botanists. As to the locality, it must be in the mountains along the Yunnan-Tonkin border as stated by the poet.

The next thing to be done was to go there to look this up. He started out on an expedition and in January 1917 succeeded in locating an immense coniferous forest of the *Cupressus* group as he had expected, along the Yunnan-Tonkin border. A collection of conifers was brought back to Japan and turned over to Hayata for study. Hayata published his finding in the same year in the paper cited above.

Hayata's identifications show that the primeval subtropical coniferous forest along the Chinese-Indo-Chinese border was formed principally of *Fokienia Kawaii* Hayata, a new species of this rare Cupressaceous genus. Other trees in the same forests were *Taxus sp., Podocarpus neriifolia* D. Don, and *Tsuga yunnanensis* Masters. Trees collected from the Yunnan side include *Juniperus chinensis* Linn., *Cryptomeria Kawaii* Hayata, (another new species), *Cupressus funebris* Endl., *Cupressus torulosa* D. Don, and *Thuja orientalis* Linn. f. *Kawaii* Hayata (a new form).

The discovery of this immense coniferous forest is not only of plant geographical and ecological interest but it also contributes to floristic botany by the discovery of several new taxa. *Fokienia* is a rare genus hitherto known only from Fukien province, China by a single species *F. Hodginsii* (Dunn) Henry & Thomas. The latter was first discovered in 1908 and described as a species of *Cupressus*. This new species considerably extends the range of the genus with this disjunctive pattern of distribution. The morphological differences between the two are slight and later authors are divided in their opinions as to whether the two should be treated as one or two species.

Another species of interest is *Cryptomeria Kawaii*. Again this species is quite similar to the only other known species of *Cryptomeria, C. japonica* D. Don, widely known in cultivation as an ornamental tree. Most botanists now relegate Hayata's new species to synonymy under *C. japonica,* but some still maintain that the Chinese and Japanese species are distinct and that the cultivated plants of *Cryptomeria* of the two countries are of separate origins.

A third species of interest is *Thuja orientalis* Linn. f. *Kawaii* Hayata. *Thuja orientalis* is an arbor-vitae so different from other species of the genus *Thuja* that it is often treated as a distinct genus *Biota*. Hitherto the plant was known only in cultivation and Kawai's discovery of a wild form is thus of particular significance in indicating its possible origin.

In this region of southeastern Asia, including the area continued further westward along the

Yunnan-Burma border, it is now well known that there existed a very rich coniferous flora of subtropical mountainous nature. Many additional rare and relict species have since been found by later collectors. Among these are *Taiwania flousiana* Gaussen and *Amentotaxus yunnanensis* Li. *Taiwania* was formerly known only from the island Formosa. *Amentotaxus* has a disjunctive range with isolated species in Formosa, Kwangtung and Hupeh provinces in China. Professor Kawai's interestingly inspired trip was the first of many expeditions that revealed the existence of this botanical treasure grove.

The moral of this tale is: It pays, even for a botanist, to read poetry.

Associates' Corner

What our dues do

Some people never seem to care where their money goes, others like to be able to account for the very last penny. These lines are addressed to the second group.

Those of us who pay our dues each year as Associates of the Arboretum may wonder from time to time how this money is spent. Well, first of all, it is deposited in a special account known as the Morris Arboretum Associates' Fund. This account is administered through the office of the Comptroller of the University and the funds are dispersed upon requisition from the Director of the Arboretum.

The major item of expenditure (over 50% of the income) is devoted to the publication of this Bulletin, which is sent free of charge to our nearly 800 Associates. The Bulletin also goes to every important botanical garden and arboretum in this country and abroad. This is very important, because these institutions in turn send us their publications, and in that way the resources of our Library are greatly enriched. Moreover, if the Arboretum had to purchase the proceedings and journals of all these other institutions the annual cost would be considerable.

Another significant fraction of the dues paid by Associates is devoted to the growing of plants which are given away each Spring at the time of the Annual Distribution. These plants have to be propagated either from seed or by cuttings; they must be potted and petted in greenhouse, cold-frame or nursery; they may require from two to four years of care before they are ready to turn over to you to take home and plant in your gardens. All this involves an appreciable expense in materials and manpower.

Every December issue of this Bulletin carries a list of the more important books added to the Library during the year just ended. Except for a few items received as gifts, these books are purchased out of the Associates' Fund. Let us say that the average number of such books is fifty per year and that the average cost per volume is $6.00 (a very conservative figure); thus the dues from Associates are adding $300 worth of books each year to a library which all of us are privileged to consult and borrow from. Since the Arboretum's regular operating budget contains no funds for the purchase of books, we Associates are, in this way, making a vitally important contribution to the intellectual resources of the institution.

Finally, what would an Arboretum be without plants? You may say it has plenty of them, but plants, like people have a definite life-span and the fine old trees which we love must one day be replaced with vigorous young stock. It is also necessary to augment existing collections in almost every plant group. Here, again, the Associates' Fund is utilized and each year several hundred dollars are drawn from it for the acquisition of new plants.

These are not all of the things our dues do, but they are the more important ones and they should make us all feel proud of the fact that we help to support an undertaking from which so many derive information, pleasure, and an awareness of growing things.

When I asked Dr. Fogg what he thought I ought to write about for this issue, he said, "Why don't you let me tell the Associates how their dues are spent and then you can sign it." So he did and I have.

Marion W. Rivinus

Book Reviews

A Trio of Picture Books

Flowering Trees of the World. Edwin A. Menninger. Hearthside Press. New York. 1962. $15.95.

The Wonderful Life of Flowers. Paul Jaeger. Translated by J. P. M. Brenan. E. P. Dutton. New York. 1961. $15.00.

Mexican Flowering Trees and Plants. Helen O'Gorman. Ammex Associados. Mexico City. 1961. $15.00.

If, as has been claimed, one picture is worth a thousand words, then the combined total of more than 725 illustrations in these three volumes should be the equivalent of almost three-quarters of a million words. This is not meant to imply that the works here considered are devoid of interesting and informative reading matter; quite the opposite is the case. It does suggest, however, that their initial appeal is to the eye rather than to the mind. Indeed, one might acquire a rather comprehensive introduction to the world of plants by simply studying these illustrations and reading their accompanying captions.

Ed Menninger has for so many years styled himself "The Flowering Tree Man", that all of us have come to accept him as such. Now, with the publication of his long-awaited book on the "Flowering Trees of the World for Tropics and Warm Climates", there are few who would care to dispute his title. Certainly the 422 colored pictures and 121 line drawings which he has assembled between two covers reveal a broad acquaintance with the more showy flowering trees of the warmer parts of the world. And the scores of others mentioned but not illustrated make one realize his need for careful discrimination in selecting the subjects for inclusion in this gallery of portraits.

The author has arranged his families and genera in alphabetical order. The text embodies information of a botanical, horticultural historial and anecdotal nature and should serve as a valuable reference source. In addition to the traditional index, the author has prepared a number of special indices. One arranges trees according to habit, habitat, economic value, etc. Another groups them according to the color of their flowers; while still another marshals them according to the countries of their origin. Whether he be an arm-chair traveler or a sojourner to the tropics, the tree enthusiast will find this volume a useful companion.

Paul Jaeger, who is Professor of Botany at the University of Strasbourg, has assembled an incomparable series of photographs to illustrate his "Wonderful Life of Flowers". Many of these are in color and are as magnificent as any flower pictures which have ever been reproduced. Although it is unfair to single out individual ones for praise, the close-up of the orchid (Plate 32) and the shot of the bromeliad (Plate 64) are particularly breath-taking. Equally superb, however, are the eighty-some monochromes. Here the head of dandelion in fruit, the closeup of the passion-flower and the cross-sections of three ovaries (Plate 31) merit special attention.

So excellent is the art-work (executed by Desfossées in Paris) of this volume that one is inclined to neglect the text. This is most unfortunate, for the author has brought together a treasure-house of information dealing with the morphology of flowers, the factors affecting their growth, the various methods and agents of pollen transfer and the value of plants to man as sources of food, drugs, perfumes, etc. One wishes that this book could be placed in the hands of every beginning student of Botany.

Those who have seen the type of Mexican calendars put out in recent years by Ammex Associados have had a pre-view of Helen O'Gorman's genius as an artist. The present volume is the culmination of many years of observation by the artist-author of the plants of her adopted country. In more than a hundred beautiful plates are portrayed in succession the trees, shrubs, vines, epiphytes, parasites, herbaceous plants, succulents and cacti of Old Mexico. Indeed, the author has borrowed from other lands, as well, and one finds here paintings of the African Tulip Tree (*Spathodea*), Royal Poinciana (*Delonix*) from Asia and Bougainvillea from South America. Since these are among the plants most widely cultivated in Mexico, their inclusion in this book should prove highly advantageous to the visitor who wishes to identify all that he sees in gardens as well as in the wild. An index of English, Spanish, Aztec and Latin names is a useful adjunct as are the short bibliography and the glossary of technical terms.

J. M. F. Jr.

(*Continued on Page 18*)

The Medicinal Garden

I. The Alkaloid Plants

John Dourley[1]

The Morris Arboretum's living collection of drug plants was started in the Spring of 1956, when a few medicinals were collected and planted out in a narrow strip of ground on the west side of the lower greenhouse. The collection was not too impressive, as it consisted merely of a few biennials and perennials that would withstand the Philadelphia climate, e.g. Digitalis, Valerian and Aconite.

In the Spring of 1957 the Arboretum was most fortunate in receiving the Founder's Fund Award of the Garden Club of America. This award was made for the specific purpose of enabling the Arboretum to establish a Garden of Medicinal Plants.

A rectangular area just below the Rose Garden was selected as a trial site and during the next three years some sixty important medicinal plants were brought together in a series of small beds.

In March 1958 the Arboretum entered a display of drug plants in the Philadelphia Flower Show in the form of an attractive garden. The public interest in this exhibit was truly amazing; there was rarely a time during show hours when the garden was not surrounded by interested people. This display was obviously quite a novelty. Although not in competition, the exhibition was given an award of merit by the Federated Garden Clubs of Pennsylvania.[2]

By the summer of 1959 our collection had increased considerably, due to the acquisition of seed from a number of botanical gardens here and in Europe. It soon became apparent that our Drug Plant Garden was totally inadequate to accommodate these additional plants, so it was decided to create a more extensive area out of what had formerly been a conifer nursery. This nursery consisted largely of mature trees which were still standing in their original rows, and it was necessary to employ the services of a bulldozer. Certain trees were marked for removal; those reprieved were considered of superior specimen value and an asset to the new garden. After ploughing, disking and leveling, the beds were laid out in an informal manner with walks and pleasing contours. (Figs. 11 and 12)

In April of 1960 the task of moving the plants into the new garden was started and by midsummer the garden was formally opened to the public.[3] Many plants were added during the spring of 1961 and, indeed, the addition of new species will doubtless continue for years to come.

A distinctive feature of the Arboretum's Medicinal Garden is that it contains tropical and sub-tropical plants as well as those which are hardy in this area. The great majority of the world's drug plants, such as quinine, ipecac, nux-vomica, etc., come from frost-free regions. These must therefore be grown in large pots and tubs which are plunged into the flower beds in mid-June, and removed to the greenhouse with the approach of autumn.

The grouping of plants in a Medicinal Garden presents a number of problems. Should they be arranged by families, by their chemical constitutents or by their therapeutic action? Or should the main objective be to create a garden which is attractive as well as educational? Our own answer to this has been something of a compromise, but we are still experimenting and will probably continue to for some time to come.

This article will concern itself with some of the plants in our collection that contain alkaloids. These are arranged systematically by genera and families.

GNETACEAE. Gnetum Family

Ephedra Gerardiana Wall. A native of India. Other species of *Ephedra* are indigenous to the United States and China. The Chinese refer to it as 'Ma huang' meaning yellow astringent, and it has been used in their medicine for several thousand years. The drug ephedrine is used today as a vasodialator. As a bronchial anti-spasmodic it is effective in the treatment of asthma and hay fever. No doubt readers are aware of the drug's presence in several proprietary brands of nasal sprays, sometimes alone or with a combination of other drugs, e.g. Isedrine; the action of the drug in this case would be to constrict the nasal mucosa. Today the drug ephedrine is produced synthetically and is rapidly replacing the natural product.

[1] This is the first of a series of articles on the Medicinal Garden by Mr. Dourley who is Assistant Superintendent of the Arboretum.

[2] See Morris Arb. Bull. Vol. 9:3. 1958.

[3] See Morris Arb. Bull. Vol. 11:4. 1960.

Fig. 11. Medicinal Garden looking south

LILIACEAE. Lily Family

Veratrum viride Ait. False Hellebore. Indigenous to the eastern United States and Canada. There are several important alkaloids obtained from the dried rhizome and roots of this plant that are used as cardiac depressants. Recent investigations have shown that the pure alkaloids show exceptional anti-hypertensive qualities. There are two important proprietaries which contain the Veratrum alkaloids at present on the market.

Colchicum autumnale L. Autumn Crocus or Meadow Saffron is found growing wild in central and southern Europe. The alkaloid colchicine is obtained from the ground bulb and seed. Although extremely poisonous, the drug is used in medicine as an anti-inflammatory in acute gout. In radiology it is reported to increase markedly the susceptibility of cancer cells to X-rays; this is presumably due to its action on mitosis. Readers will undoubtedly know of its use in plant breeding to induce polyploidy.

RANUNCULACEAE. Buttercup Family

Aconitum Napellus L. This species of Monkshood is indigenous to Europe although the genus is well represented in Asia. Aconite is grown commercially in Germany, Italy, France and Spain for export in the form of dried root. The principal constituent of the plant is the alkaloid aconitine, a virulent poison if administered in large doses. It is used medicinally as a powerful sedative, anodyne and febrifuge, and externally in the form of a liniment as a local analgesic in facial neuralgia and toothache.

Hydrastis canadensis L. The Golden Seal is a perennial herb native to the eastern United States. The parts used are the rhizome and root which contain the alkaloids hydrastine and berberine. The principal use of Hydrastis and its preparations is as a bitter or stomachic, however hydrastine hydrochloride is used as a vasoconstrictor in the treatment of uterine hemorrhage, and locally as a styptic in nosebleed.

PAPAVERACEAE. Poppy Family

Papaver somniferum L. The Opium Poppy is indigenous to Asia Minor, and is cultivated in North Africa, India, Turkey and the Balkan States, although its cultivation has been reduced considerably by the international regulation of traffic in narcotics. Opium (gum opium) is the air-dried milky exudation obtained by incising the unripe capsules of the poppy. The opium alkaloids are many but the important ones are morphine, codeine, narcotine and papaverine, which are used in turn as analgesic, anti-tussive and anti-spasmodic. These alkaloids are contained in many medicinal preparations. As a point of interest, heroin is the most habit-forming of the opium alkaloids, and therefore is prohibitive in manufacture and sale, although illegal traffic in such does exist.

STERCULIACEAE. Sterculia Family

Theobroma cacao L. Cacao or Chocolate. Native to South America. Apart from its delicious beverage cocoa, the purine alkaloid theobromine, is prepared from the dried ripe cacao seeds of the plant, or produced synthetically. Theobromine is used as a diuretic and cardiac, respiratory and psychic stimulant.

UMBELLIFERAE. Parsley Family

Conium maculatum L. Poison Hemlock. A native of Europe. This plant is included in our collection of alkaloid-bearing plants and is hardly worthy of mention, at least from the point of view of medicine, but it is not without great popularity. The poison hemlock with its association with the death of Socrates intrigues the school children, so, for the benefit of the young students of ancient Greek history, the plant will remain. The alkaloid coniine was once used as a sedative but was found to be too dangerous for future use. Coniine was used by the Greeks as a state poison. The death of Socrates in 399 B.C. resulted from respiratory paralysis, caused by compulsory drinking of the cup of hemlock.

LOGANIACEAE. Logania Family

Strychnos spp. An important genus, belonging to the same family as *Buddleia,* which is widely spread throughout the tropical world. It is well represented in Africa, where no doubt in the past it found employment as an ordeal poison, and in South America as an arrow poison. (*S. toxifera* Schomb.) The genus consists of trees and woody vines which yield toxic alkaloids, usually the convulsants strychnine and brucine.

S. nux-vomica L., a native of India and Burma, is most widely used as a source of these drugs. The alkaloids are obtained from the dried ripe seeds of this species. Although Strychnine taken in excessive doses is a virulent poison, medicinally administered it is quite an important drug as a tonic and central nervous system stimulant. Brucine is used in tonics; it is extremely bitter and therefore does stimulate salivary and gastric secretions.

APOCYNACEAE. Dogbane Family

Rauwolfia serpentina (L.) Benth. Snakeroot. Used in India for many centuries in primitive medicine, it is now making a great contribution to modern medicine as anti-hypertensive agents and tranquilizers. Reserpine is the pure crystaline alkaloid obtained from the resin fraction of the root of this species. There are a number of proprietary brands on the market that contain *Rauwolfia* or its constituents, e.g. Raudixin (Squibb) Rauwiloid and Serpasil (Ciba). The latter contains reserpine in a purified form. Among the other species of *Rauwolfia* in our collection are *R. hirsuta* Jacq. from Mexico and Central America and *R. verticillata* (Lour.) Baill. from southeastern Asia.

Vinca rosea L. (Madagascar). The alkaloids from this plant have cardiac properties and according to reports possess great possibilities as anti-diabetics.

Fig. 12. Medicinal Garden looking north

Alstonia scholaris R. Br. Dita Bark. A tall evergreen tree widely cultivated throughout India. The use of Dita as a healing agent dates back to ancient history. The bark yields alkaloids used as astringents and bitter tonic, but primarily used as a febrifuge.

SOLANACEAE. Nightshade Family

This family makes quite a contribution to our Medicinal Garden, each genus being represented by several species.

Atropa belladona L. A native of Eurasia. The drug Atropine is derived from the roots and leaves and is used in medicine as a sedative, antispasmodic and anodyne; as a secretary depressant during anesthesia; and in ophthalmic medicine as a mydriatic.

Datura Stramonium L. Jimson Weed. This native of tropical Asia is the source of Scopolamine, used as a pre-anesthetic in surgery and childbirth and in the prevention of motion sickness.

Hyoscyamus niger L. Henbane. (Eurasia). The chemical constituents are the same as above, the action being anti-spasmodic, hypnotic and sedative.

H. muticus L. (Egypt) is grown for its hyoscyamine content, from which atropine is extracted.

RUBIACEAE. Madder Family

Cephaelis Ipecacuanha (Brot.) Rich. Brazil. Ipecac is a member of the Madder or Gardenia family. Ipecac consists of the dried roots which contain the alkaloids emetine and cephaeline used in the treatment of amoebic dysentery. The drug is of great importance to India where the disease is most prevalent.

Cinchona spp. This genus is represented in the drug plant collection by these important species: *C. Calisaya* Wedd. (yellow bark), *C. succirubra* Pav. (red bark), and C. *Ledgeriana* Moens. (Ledger bark). The natural distribution of this genus is known to extend from the mountains of southern Costa Rica and northern Panama, through the Andes of Colombia, Venezuela, Ecuador and Peru into Bolivia. The drug quinine is obtained from the dried bark of the tree and is a specific in the treatment of malaria. The importance of this drug to the people in the tropical and sub-tropical regions of the world cannot be too strongly emphasized. Apart from quinine's importance as a febrifuge, it has been found that combined with urea, as quinine and urea hydrochloride, it serves as a very effective sclerosing agent in the treatment of varicose veins.

Coffea arabica L. A native of Africa, Coffee is a source of the purine alkaloid caffeine, which is obtained from the beans. The purine alkaloids act in general as central nervous system stimulants and as diuretics. Caffeine is often used in combination with analgesic drugs for the relief of headaches. In the United States the drug is produced synthetically.

LOBELIACEAE. Lobelia Family

Lobelia inflata L. Sometimes known as Indian Tobacco, this species is a native of the United States and Canada and was used as a substitute for tobacco by the Indians. Lobeline is the alkaloid derived from the leaves and flowering tops and is the basis of a proprietary preparation that enables asthmatics to break the smoking habit. It creates a respiratory stimulation similar to tobacco, but eliminates the irritable effect on the lungs. Lobelia tincture is used as an expectorant and emetic.

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Book Reviews

(Continued from Page 14)

A Practical Book

The Art of Training Plants. Ernesta D. Ballard. Harper and Brothers. New York. 1962. $4.75.

Mrs. Ballard has written another useful book for the plant grower. This new book is one on training plants for decorative purposes. The book is divided into five chapters. The first one on "Some Decorative Plants" describes the essentials of traditional bonsai, tropical bonsai for indoor growing, herbaceous plants decoratively grown, succulents in ornamental containers, epiphytes on driftwood, group plantings and dish gardens, potted topiary and cascades. It gives instructions on how these are to be prepared, methods of caring, and the kinds of plants to be used. The second chapter describes the techniques of pruning and shaping and the third of root-pruning and potting. The fourth chapter is on soils, fertilizing, watering and spraying. The fifth chapter gives sources where plants and supplies can be obtained and a list of references as suggested reading. There are photographs of plants illustrating various points and an index.

The value of this book lies in the fact that it contains all practical instructions: instructions that have been gained through the actual experimenting by the author. With this book in hand, any plant grower or amateur gardener will be able to grow successfully any of the types of decorative plants herein described, from the Japanese bonsai to fancy pots of topiary.

H. L. Li

Arboretum Activities

(Continued from Page 2)

ed as being limited to twenty, the demand for this course was such as to require admitting double that number. Even at that, several applicants had to be turned away, simply because the seating capacity of our one available classroom cannot be stretched beyond certain fixed limits.

The enthusiastic response to this series is taken as a clear indication of the need for providing this type of instruction and we shall endeavor from time to time to offer such courses as lie within the competence of our staff. These will be made known to our Associates through the medium of these pages as well as by postcard mailings.

What are those Bags for?

Beginning in the early spring and continuing through June, visitors to the Morris Arboretum are often confronted by trees of many species whose branch tips appear to have been "gift wrapped." The keen observer will also notice an identification tag on each of the bagged branches. An explanation of this phenomenon might be stated: DO NOT DISTURB — HYBRIDS BEING PRODUCED. This is part of the forest genetics research conducted by the U. S. Forest Service's Northeastern Forest Experiment Station, whose geneticists have been stationed at the Arboretum since 1946.

Although some work has been done on twenty-one tree genera, the bulk of the breeding has been concerned with the pines and spruces. The bags used for these latter genera are made of Visking sausage casing, a material which permits the free passage of air while keeping out unwanted pollen. The branches are bagged before any pollen is shed from the parent tree or from any species with which it will cross. All male flowers (strobili) are also removed from the branch area to be bagged. Regular examinations then determine the optimum stage of receptivity of the female conelet. When this stage is reached, a small hole is made in the bag and the desired pollen is injected by means of a syringe or eye-dropper. The hole is then closed with tape. Usually the bags are left on the trees until well after the receptive period of the female conelets has ended, about two to four weeks. After the bags are removed, it is just a matter of time (fall for spruces, fall of the following year for pines) before the cones can be harvested and the hybrid seed extracted.

Hybrids made using Arboretum trees as parents are under test in seven states from Maine to Maryland. The rich exotic flora of the Philadelphia area has made an important contribution to the progress of forest-tree improvement.

New Council Members

It is a pleasure to announce that the following persons have accepted the invitation of President Harnwell to serve as members of the Advisory Council of the Arboretum:

Mrs. Frederick W. Morris
Mr. Richard T. Nalle
Mr. R. H. L. Sexton

Plant Distribution

Friday and Saturday, May 25 and 26 have been selected as the days for the annual distribution of plants to our Associates. Prior to these dates members will receive individual notices of this event, together with a list of the species which will be available.

J. M. F., Jr.

MORRIS ARBORETUM ADVISORY COUNCIL

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Morris Arboretum Bulletin

JUNE, 1962

VOL. 13 NUMBER 2

Halesia diptera

Published by
The ASSOCIATES of
THE MORRIS ARBORETUM

The Morris Arboretum Bulletin is published quarterly at Philadelphia, Pa., by the Associates of the Morris Arboretum, Chestnut Hill, Philadelphia 18. Subscription, $1.50 for four issues. Single copies, 40 cents. Free to Associates.

THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

On April 2 the Director spoke to the Philadelphia Section of the American College of Dentists on the topic, "The Search for New Drug Plants". On April 18 he gave an illustrated lecture on "The Road to Mandalay" to the Friends of the Library of the Bala-Cynwyd Library Association and on April 23 he delivered the inauguration address at the Spring Meeting of the Delta Chapter of Phi Beta Kappa held at the Faculty Club of the University of Pennsylvania; his subject was "Botany and Medicine."

Dr. Allison spoke to the Senior Biology Students at Radnor High School on April 24 on "An Introduction to the Nuclear Life Cycles in the Fungi." On May 6 she attended the Thirteenth Mid-Atlantic States Conference on Dentistry at Buck Hill Falls where she gave an illustrated lecture on "Fungi in the Field and Elsewhere."

Visting Lecturer

The Arboretum is fortunate in having had as its guest this Spring Dr. Arthur S. Boughey who is Professor of Botany at the University of Southern Rhodesia and Nyassaland. Dr. Boughey is at present in the United States on a Rockefeller grant for the purpose of continuing his studies on the Origin of the Angiosperms.

(Continued on Page 37)

The Styracaceae in the Philadelphia Area

Edith C. Gall

Since some of the showiest members of the Styracaceae or Storax Family are native to Eastern United States, it is rather surprising that this group of plants is not better known horticulturally. The family consists of thirteen genera and about 120 species of trees and shrubs indigenous to the warmer parts of North and South America, eastern Asia, Africa, and the Mediterranean region. The genera *Rehderodendron, Sinojackia, Huodendron, Parastyrax, Afrostyrax, Bruinsmia, Pamphilia, Alniphyllum, Lissostyrax,* and *Melliodendron* are either not believed to be hardy in the Philadelphia area or are not in cultivation, but *Halesia, Styrax* and *Pterostyrax* are well adapted to our climate and are worthy of a place in any collection of ornamental trees.

The regular, perfect, campanulate flowers occur in axillary or terminal fascicles or racemes. They are four- to five-lobed and are often united only at the base. The ovary may be either superior or inferior; and the fruit is a berry or drupe, often dry and dehiscent, occasionally winged. The alternate leaves have no distinctive autumnal color in *Styrax,* but in both *Halesia* and *Pterostyrax* they turn an attractive yellow.

Halesia L. The Silverbell Tree

Until recently, it was thought that the genus *Halesia* was confined to the southern Atlantic region of the United States, where there are found two species which are trees and two which are shrubs. However, in 1924 Ren-Chang Ching collected specimens from a tree in Chekang, China, which Woon Young Chun reported as a new species, *H. Macgregorei.* This plant is named for the Superintendent of Parks in Shanghai, Mr. Donald MacGregor, who is responsible for the introduction of both native and foreign plants to Chinese gardens.

Halesia is thus another of those genera originally thought to be endemic to Eastern North America but now known to have counterparts in Eastern Asia. Other examples are *Carya, Liriodendron, Sassafras, Nyssa* and *Symphoricarpus.*

Halesia, named in honor of Stephen Hales, the author of "Vegetable Statistics", has a four-lobed sympetalous corolla with an inferior ovary which produces a dry oblong drupe with two or four longitudinal wings. The white, campanulate flowers are pendulous in axillary clusters on one year-old wood. As the wood becomes older, the bark takes on a distinctive pattern of green and white longitudinal streaks. The alternate, serrate-margined leaves turn yellow in the fall. Of the four eastern North American species, three are hardy in Northeastern United States, probably as far north as Massachusetts, and the fourth is hardy at Mrs. J. Norman Henry's Arboretum in Gladwyne, Pa.

H. carolina L.

A tree or large shrub from the foothills of the southern mountains to nearly sea-level, it was probably first noted by Mark Catesby in 1731 and was introduced to American gardens by 1756. It grows about twelve to eighteen inches a year and in ten years should attain full growth with spreading branches (Fig. 13). The corolla, though smaller than that of *H. monticola,* is handsome in late April or early May (Fig. 14). Although its native range is from West Virginia to Florida and eastern Texas, *H. carolina* has proved hardy as far north as Massachusetts and is perhaps the hardiest of the Silver Bells. The

Fig. 13. *H. carolina*

Fig. 14. *H. carolina*

Fig. 16. *H. monticola*

fruit, which is a characteristic dry drupe with four winged angles terminated by a persistent style, ripens in late autumn and remains on the branches until winter.

H. monticola (Rehder) Sargent

The mountain Halesia, more tree-like since it attains a height of 80 to 90 feet with a single trunk, is a magnificent sight in spring with its profusion of dainty, pendulous bell-shaped flowers (Fig. 15). Its range is from North Carolina to Tennessee and Georgia, and is usually confined to altitudes above three thousand feet. The flowers are slightly larger than those of the preceding species, and in addition the corolla flares outward while in *H. carolina*, it is incurved at its tip. (Fig. 16). In both of these species the fruit is four-angled. (Fig. 17).

Fig. 15. *H. monticola*

There are two variations worthy of mention: *H. monticola* var. *vestita* Sarg. which has leaves that are more tomentose beneath in their early growth; and *H. monticola* var. *rosea* Sarg., whose flowers in their early stages of opening are pale rose colored, giving a beautiful and unusual aspect to the tree. Both of these originated at Thomas Meehan's nursery outside of Philadelphia, and seedlings and cuttings of them were sent to the Rochester Parks System.

H. diptera Ellis

This species differs rather markedly from the two preceding ones. It is an inhabitant of low wet woods on the boarders of swamps in the coast region of the south Atlantic and Gulf States from South Carolina to northern Florida and eastern Texas, west to the Mississippi River and northward through Louisiana and Arkansas. It will, however, grow fairly far north although it is not as hardy as the other members of this genus. Also it flowers perhaps three weeks later than the other Halesias.

Fig. 17. *H. monticola* fruit

Fig. 18. *H. diptera* fruit

The most striking difference is the oblong, compressed fruit that has only two broad wings, although occasionally narrow supplementary wings may form between them (Fig. 18).

Most authors refer to this species as a shrub or small tree, rarely attaining a height of thirty feet, with horizontal branches that form a low broad head. However, the older of our two trees is taller than *H. monticola* and is at least fifty feet. (See cover.)

H. diptera brings a note of charm and cheerfulness to the dark waters of impenetrable pine swamps in mid-May. Because of this, John Ellis introduced it to English gardens as early as 1758, when he commissioned Dr. Alexander Garden, a South Carolina physician for whom *Gardenia* is named, to send specimens to Europe.

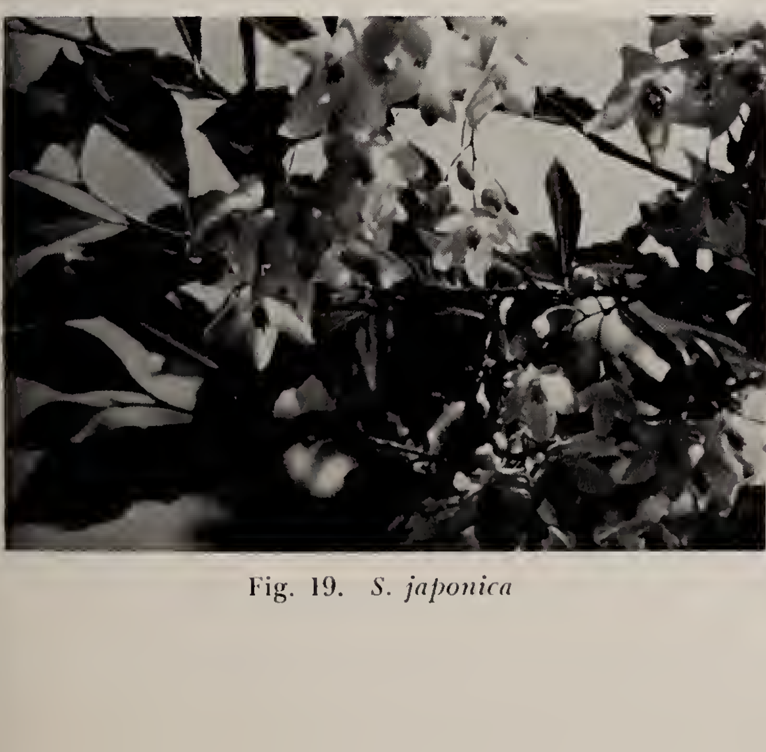

Fig. 19. *S. japonica*

H. parviflora Michx.

Although this species is indigenous to Northern Florida and Mississippi, Mrs. J. Norman Henry has been successful in finding a strain from northern Florida that has proved hardy in the Henry Foundation at Gladwyne, Pa.

In its native habitat of the woods and hillsides of the Coastal Plain it is said to become a small tree, while in this section it is more shrubby. The corolla is campanulate but only one centimeter long. The fruit is four-winged and clavate.

Halesias may be propagated from seeds; greenwood cuttings from forced plants; root cuttings taken in spring or autumn or from layers. Seed should be sown when ripe, (or stratified), and not allowed to dry out, otherwise germination will not take place until the second year. The Halesias are easily transplanted and will thrive in almost any good soil, although they prefer a rich well-drained soil and a sheltered position.

Fig. 20. *S. Obassia*

Styrax L. Snowbell Tree

This genus of about 100 species, predominantly represented in the tropical or subtropical regions of America, Asia and Europe, has a few representatives which are hardy in our area and are definitely worth growing for their ornamental value.

Styrax comes from the word Sturax, applied to this plant by Theophrastus and Dioscorides. It is a mere alteration of assthirak, the Arabic name for *Styrax officinalis,* a native of Syria and the Levant.

The suggestion of a medicinal use comes from the specific name *officinalis.* It is a stimulant and expectorant, formerly prescribed for asthma and chronic afflictions of the windpipe. A powerful and fragrant balsam called storax is obtained from it. In the early nineteenth century this was frequently burned as incense.

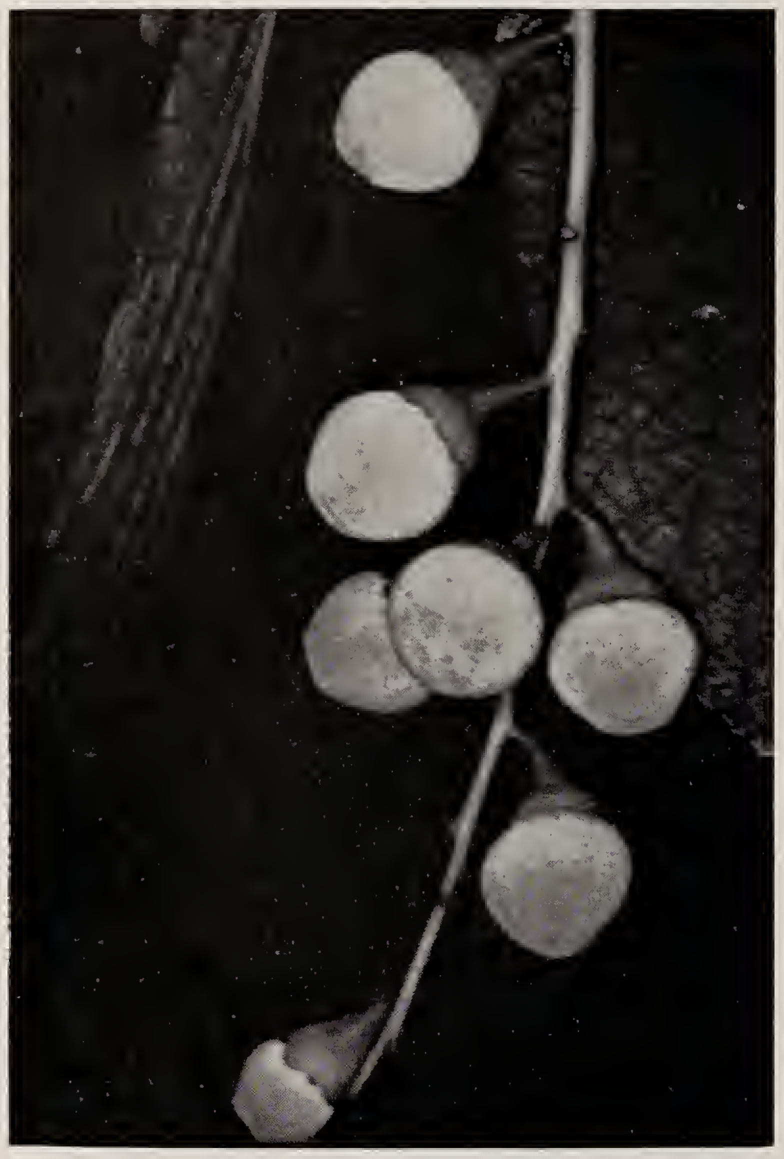

Fig. 21. *S. Obassia* fruit

The white, deeply five-lobed, campanulate corolla subtends a superior ovary which produces a subglobose dry or fleshy drupe with an irregularly dehiscent pericarp. The flowers are pendent on the underside of the branches in racemes or clusters. This may tend to be a disadvantage for viewing the flowers, but if the trees are placed on elevated ground so that they may be viewed from below, nothing then distracts from their beauty. The leaves, which are either entire or serrate, are alternate and do not produce distinctive autumn color, but the racemes of drupes are interesting and different. The bark cracks in a netted fashion and has a contrasting lighter layer beneath.

S. americana Lam.

This shrub growing to ten feet, is not generally considered hardy in our area, but again Mrs. J. Norman Henry is able to grow it. Its native range is from Virginia to Florida, west to Missouri and Louisiana as a river bank inhabitant. At present it is not in cultivation at the Morris Arboretum.

S. grandifolia Ait.

A small tree from the woods and sandy riverbanks of the Coastal Plain from Florida to Louisiana northward to southern Virginia which has also proved hardy at the Henry Foundation in Gladwyne. Its white flowers are very sweetly scented.

S. japonica Sieb. and Zucc.

A very interesting laterally branched tree which attains a height of about thirty feet. Although it was introduced from Japan and Korea in 1862, it is still little known. Its many fine qualities entitle it to be more widely grown. The abundance of dark green leaves partially conceal the fragrant white hanging flowers in late May, but the bark is also worthy of note. It is light tan, finely lined and smooth, sometimes having a tendency to loosen in a thread-like arrangement, thereby showing a light color beneath.

The flowers, ranging from 3 to 6 in a cluster, have a spreading corolla of five white petals. They are about one inch in diameter (Fig. 19). The ovary which is superior, produces a dry drupe; the pericarp of a lighter color is dehiscent, leaving the dark brown fruit exposed.

S. Obassia Sieb. and Zucc.

A small tree of columnar habit, with the ascending branches attaining a height of 30 feet, which was introduced from Japan in 1879 because of its long racemes of many fragrant flowers. (Fig. 20). Since the leaves are larger in this species they tend to hide the flowers, even though the racemes are considerably longer than in *S. japonica*. This, however, should not deter one from growing this tree, which when properly planted, can be appreciated in its full beauty. Its fruit is also handsome and similar to *S. japonica* except that it is more noticeable owing to the longer inflorescences. (Fig. 21).

Fig. 22. *P. hispida*

Fig. 23. *P. hispida* fruit

S. dasyantha Perkins

A native of Hupeh, China, this species was discovered by Henry and again by Wilson in 1900. A deciduous shrub or small tree, the young branchlets covered at first with a reddish-brown pubescence soon become glabrous. It, too, has large leaves partially concealing the slender racemes of white, one-half inch flowers. This is a later flowering species, following *S. Obassia* by at least one month and *S. japonica* by a few weeks.

This is a new introduction to the Morris Arboretum this spring, but it should prove successful with us as Rehder designates it as hardy in Zone V.

Most species of *Styrax* need careful attention when young; except perhaps *S. Obassia,* which seeds itself readily here. They like a sheltered spot, and when first planted out should have a sandy loam, to which decayed leaves and, if available, some finely broken-up peat has been added. Once established, they will root into the surrounding soil. Cuttings of *S. japonica* and *S. americana* may be rooted, but they as well as the others succeed better when raised from seed.

Pterostyrax Sieb. and Zucc.

Originally this genus was considered a part of *Halesia,* but there are many reasons for separating it. *Pterostyrax* is exclusively Chinese and Japanese, containing four species, while *Halesia* is predominantly North American although one species has recently been reported from China. The inflorescence is paniculate and many-flowered (Fig. 22) compared to the small, clustered inflorescence of *Halesia;* the parts of the flowers are in fives, while those of *Halesia* are in fours; the stamens are protruded compared to enclosed; the pith is continuous instead of chambered.

The name comes from the Greek *pteron,* winged and *styrax,* referring to the winged fruit (Fig. 23) which develops from a partially inferior ovary.

Pterostyrax hispida Sieb. and Zucc.

Known as the Epaulette-tree because of its fruit, this is apparently the only species of four that is hardy in the Philadelphia area. Introduced from Japan in 1875, it is a tree to 40 feet with coarse, vigorous growth and spreading habit. The white fragrant flowers are produced in June in axillary, downy, pendulous panicles. The corolla is five-lobed, divided almost to the base and about one-third of an inch long.

The Epaulette-tree prefers moderately loamy soil and a sunny position. The young trees suffer some winter killing, making pruning necessary.

The species is best propagated from seed sown in autumn soon after ripening, although greenwood cuttings under glass and layers are also successful.

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The Chromosome Number of Quercus Dentata

Frank S. Santamour, Jr.[1]

Numerous studies have established that the normal reduced chromosome number of the genus *Quercus* is n = 12. Of the more than 50 species and hybrids reported thus far, all are diploid: 2n = 24. Some earlier reports of somatic numbers (2n = 8, 12, and 22) have been eliminated from consideration by later and more critical studies. Johnsson (1946) found that triploids may occur in twin seedlings of *Q. robur* L, but otherwise polyploidy appears to be absent in this genus. The occurrence of a polyploid species in such a cytologically uniform genus would be especially noteworthy, perhaps indicating that a further search would disclose more extensive polyploidy.

In their listings of chromosome numbers, Darlington and Janaki-Ammal (1945) and Darlington and Wylie (1955) gave the somatic number of *Q. dentata,* one of the Chinese oaks, as 2n = 48 (tetraploid). In the earlier report this number is preceded by a question mark, whereas in the more recent compilation the question mark has been omitted.

The original work cited for this count was H. J. Sax (1930), but Mrs. Sax's paper included no data on the chromosome number of *Q. dentata.* However, she did report the average pollen-grain diameter of two specimens at the Arnold Arboretum as 8.7 and 11.2 units, compared to ca. 7.3 units for the rest of the species studied. The tree producing the larger pollen also had 80 percent pollen sterility, she reported, while pollen from the other tree was 8 percent sterile and the rest of the species gave pollen sterilities ranging from 3 to 10 percent. Although pollen-grain size is sometimes indicative of the degree of ploidy, no suggestion was made that this species was tetraploid. Apparently the compilers of the chromosome lists were responsible for this interpretation.

Because of the widespread circulation of unfounded information about the polyploid nature of *Q. dentata* — and also because of the possibilities of utilizing polyploids in genetics studies and tree-improvement research — it was decided to investigate the cytology of *Q. dentata.*

[1]Geneticist, Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The forest genetics research reported here was conducted by the Northeastern Station in cooperation with the Morris Arboretum of the University of Pennsylvania, Philadelphia, Pennsylvania.

Materials and Methods

The Morris Arboretum has planted as many as 24 specimens of *Q. dentata,* and 16 are still alive. These trees were checked in September 1961 to determine their acorn production. Most of the trees had some acorns, but the greatest production was on a group of 15-year-old trees on the farm area. These trees are well isolated from flowering specimens of other species and receive adequate intraspecific pollination. Acorns were collected from several trees on September 21 and were sown immediately in the greenhouse. Root tips were taken and were fixed soon after germination on October 26, 1961.

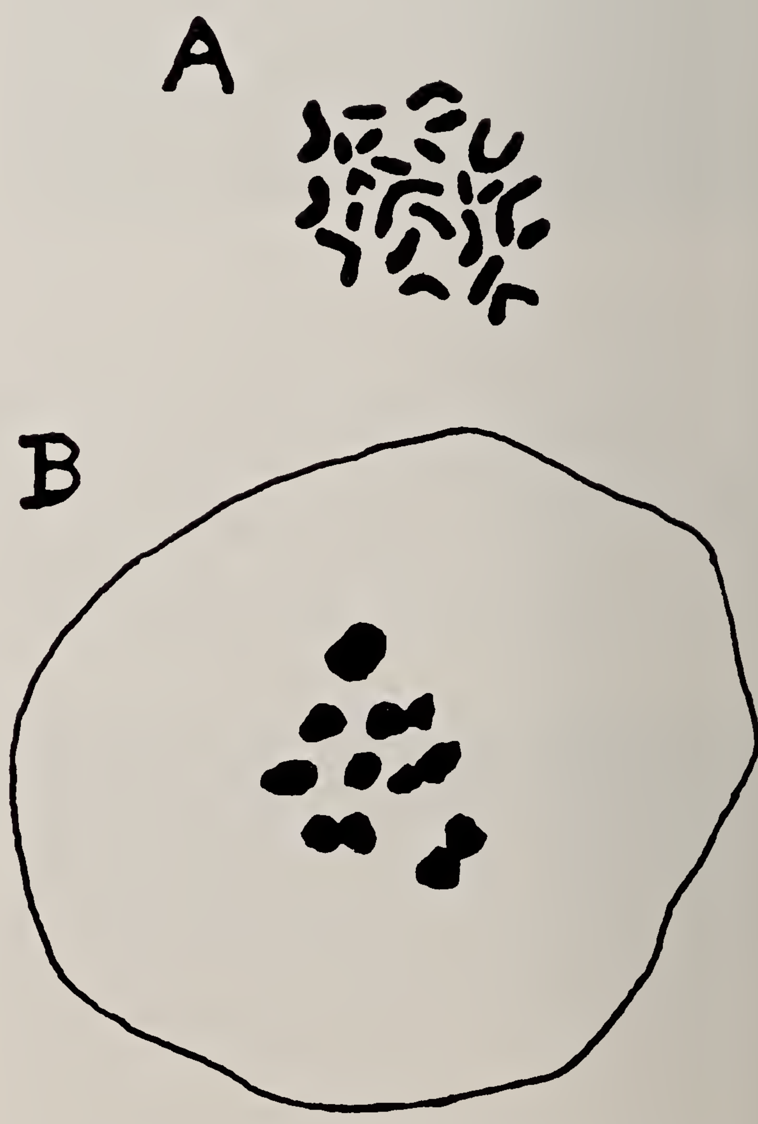

Fig. 24. (A) The somatic chromosomes of *Q. dentata,* (2n = 24). (B) Meiotic metaphase I in pollen mother cell; note secondary pairing of the bivalents (n = 12). 2500 X.

TABLE 1.—CHARACTERISTICS OF POLLEN PRODUCED AT TWO DIFFERENT PERIODS

Tree Number	Time Pollen Formed	Pollen-Grain Diameter (Units[1])											Average Diameter	Pollen Sterility
		6	7	8	9	10	11	12	13	14	15	16		
		Number of Grains											*Microns*	*Percent*
M 366	Fall 1961	1	15	45	34	10	1	—	—	—	—	—	22.8	27
M46-562-G	"	—	—	—	2	15	24	39	12	6	1	1	32.2	59
M46-562-N	"	—	—	7	27	36	22	7	—	1	—	—	27.5	56
M 366	Spring 1962	5	70	23	1	1	—	—	—	—	—	—	19.9	1
M46-562-G	"	10	59	29	2	—	—	—	—	—	—	—	19.9	7
M46-562-N	"	10	76	4	—	—	—	—	—	—	—	—	19.4	5

[1] One unit equals 2.75 microns.

It was noted on September 21, 1961, that some flower buds had broken on most of the trees, and in some cases the emerged catkins were about 2 cm. long. Both open and closed buds were collected and fixed on September 22. Collections of normal flower buds were also made in the spring of 1962.

Both root tips and flower buds were fixed for 24 hours in 3:1 alcohol-acetic with a little iron chloride added, and then were stored in 80 percent ethyl alcohol.

Mature pollen grains from closed or dehisced anthers were mounted in aceto-carmine glycerine jelly and checked for pollen sterility, based on aborted and unstained grains. Determinations of pollen sterility were made on 100 randomly selected pollen grains, and pollen size was determined by measurements of 100 normal grains. Pollen measurements were made with an ocular micrometer at a magnification of 690 X.

Results and Discussion

Chromosome Counts

Chromosome counts were made on the root tips of freshly germinated acorns from three trees. The somatic number was $2n = 24$, which is the normal diploid number for the genus. The chromosomes are shown in Fig. 24 (A). Natividade (1937) found that the chromosomes of the oak species he studied ranged from 1.4 to 3.8 microns in length, while Duffield (1940) stated that none of the chromosomes in his work were longer than 6 microns. The chromosomes of *Q. dentata* appear to range from about 1 micron to just over 4 microns in length, and probably are not appreciably different from the average generic karyotype.

No countable meiotic stages were found in the flower-bud material fixed in September 1961. Most of the anthers in even partially elongated catkins contained mature pollen grains; and the earliest stage observed, in only one catkin, was the tetrad stage.

Meiosis was also studied in normal flower buds in the spring of 1962. When branches were brought into the laboratory as early as March 23, the catkins elongated normally and meiosis took place in as little as 11 days. The wave of meiosis in this material proceeded from the base to the tip of the catkin. Chromosome counts at metaphase and other stages gave $n = 12$ as the haploid number. The meiotic chromosomes are shown in Fig. 24 (B). There was some secondary pairing at metaphase as noted by Sax (1930) and Natividade (1937), but there were no other irregularities. Whether this association is indicative of a polyploid origin of *Quercus,* as suggested by Natividade (1937) is questionable.

Pollen Studies

Since *Q. dentata* is undoubtedly a diploid, there still remained the problem of the high pollen sterility and large pollen size noted by Mrs. Sax. To study this problem, comparisons were made of pollen produced by three trees both in the fall of 1961 and spring 1962. Pollen was expressed from fixed material of closed anthers, and slides were made in aceto-carmine glycerine jelly. The procedure followed in this work has been described above. The results of the pollen study are given in Table 1. Pollen produced in the fall is characterized by high sterility and large size. Spring-produced pollen is highly fertile and is of a size well within the generic range.

The precocious bud-bursting and meiosis of *Q. dentata* in the fall of 1961 may have been the result of unusually mild weather. The average temperature for September 1961 was 71.5°F., the warmest since 1931.[2] Physiological disturbances resulting from this off-season blooming may have been the cause of the abnormal pollen production.

[2] U. S. Department of Commerce, Weather Bureau, Local Climatological Data, Philadelphia, Pennsylvania, 1961.

The average September temperature for 1929 in Philadelphia was also high — 70.3° F. The fall of 1929 was also mild in Boston, Massachusetts, the site of the Arnold Arboretum. The first fall frost in Boston that year was on November 22, compared with an average date of October 29.[3] It may be possible that some fall-produced pollen was included in Mrs. Sax's samples.

Some of the large pollen grains produced in the fall took stain well with aceto-carmine, and probably are viable. They are also possibly polyploid. And it is not unlikely that some of the giant pollen may take part in pollination and fertilization. Such an occurrence might even result in the production of polyploid trees. However, studies on controlled pollination and progeny testing are needed to determine if these theoretical possibilities actually can take place.

[3]U. S. Dept. Agriculture, Climate and Man, U. S. Dept. Agr. Yearbook, 1941. 1248 pp., 1941.

SUMMARY

Quercus dentata Thunb., previously reported as a tetraploid, was found to be a diploid with n = 12, 2n = 24 chromosomes. High pollen sterility and large pollen-grain size, which may have been responsible for the tetraploid interpretation, are caused by precocious meiosis during the fall.

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New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since March, 1962:

Mrs. E. Page Allinson
Mrs. H. Henry Brown
Mrs. Brian L. Daly
Mrs. Theodore E. Eckfeldt
Mrs. Caleb F. Fox, 3rd
Mr. William H. Frederick, Jr.
Mrs. Richard W. Gagne
Mrs. William J. C. Hughson
Mr. R. Kemp Johnson, Jr.
Dr. & Mrs. Edward Korostoff
Mr. Constantin Pervanis
Mr. Everett G. Rodebaugh
Mrs. Robert S. Ross
Mr. Joseph S. Schmuckler
Mrs. George Starrels
Mr. John P. Taylor
Mrs. Wyllys Terry
Mrs. William Heyl Thompson
Mr. & Mrs. Rutherford P. Todd
Mr. Ted Varvalow
Mrs. L. W. von Seldeneck
Mr. John F. Whelihan, Jr.

Injury and Healing of Ilex Opaca

Patricia Allison

American Holly (*Ilex opaca* Ait.) is indeed the plant of many contrasts: brilliant berries and dark foliage; smooth leaf surfaces ringed with spines; a centuries-old reputation for wood with magic powers unrelated to any correspondingly noteworthy physical strength; frailty before the storm in some quarters and ability to withstand the gale in others; proneness to breakage by snow, but resistance to cold; remarkable growth responses to injury that may be harmful as well as beneficial. Because they are relevant to the maintenance of health and beauty in our gardens, a consideration of a few of these contrasting characteristics is in order.

Folklore and Wood Strength

In his discussion of the American Indian use of the holly motif in embroideries of clothing and shields, Dengler (1) suggests that the spiny leaves represented fierceness and that the toughness of the wood indicated unwillingness of the Indians to submit to enemies. But in going to battle, they evidently relied more on the sprig of holly attached to their clothing than to weapons made of the wood. Is holly wood tough?

The wood is chalky white with rather abundant soft tissue mingled with the woody elements in the close grain (7). Blocks of it are relatively heavy. When dried to 15% moisture content, a cubic foot would weigh almost 40 pounds, compared to 26 for *Tilia americana*, 36 for *Ulmus americana*, and 47 for *Quercus borealis*. It is also hard and highly resistant to shock. This type of "toughness" which makes the wood useful for small turnings and instruments, is coupled with low beam or column strength (9). It is brittle, and its screw-holding capacity, while moderate, is far below that of the best cabinet woods. (3). Thus, in 1878, when large holly trees were much more plentiful and the wood was an item of commerce, it was supplied to the trade in short chunks, for making small items rather than load-bearing members (2).

Fig. 25. Healed branch of *I. opaca*

Fig. 26. Presumed condition of branch in Fig. 1. before healing.

Storm Resistance

Following a disasterous glaze storm in Wisconsin, Rogers (8) made a study of the damage to some 2000 trees representing 40 species. As a result he concluded that there were six important storm resistance factors. These are: 1. Small surface exposure; few stout twigs rather than many fine ones. 2. Shortness of limb, (Small trees fared better than large.) 3. Horizontal branching. 4. Flexibility. 5. Strength of material. (The strength of oak wood overcomes the suboptimal architecture of the tree.) 6. External support. (Some small trees survive by leaning on others or bending to the ground before breaking).

Fig. 27. Longitudinal section of branch in Fig. 25 showing young wood.

Fig. 29. *I. opaca* growing over tight label.

Ilex opaca is low in several of these resistance factors. As Hirt (4) emphasizes, the retention of broad leaves is a distinct disadvantage to the plant when heavy, wet snow falls (factor 1). Weaknesses in factors 4 and 5 are additional shortcomings during glaze, heavy snow, and wind.

Recuperative Power of Holly

As would be expected, damage by heavy snows and wind has occurred from time to time in the collection of American holly at the Arboretum. The recuperative power of holly is great however, and even severe damage can be overcome, especially in small branches. The peculiar shape of the twig in Figure 25, cannot be formed by bending. The wood snaps before the acute angle is attained (Fig. 26) yet such a twig, nearly broken through, recovered and formed the peculiar branchlet. The evidence of the fracture lies deeply buried inside (Fig. 27).

The rapid overgrowth of wounds makes up for the proneness to breakage in part. Even when the whole top of a 15 to 20 year-old plant has been broken off, rapid healing has occurred accompanied by the vertical growth of one or more branches that restores the shape of the tree.

Fig. 28. *I. opaca* growing over loose label.

Fig. 30. *I. opaca* broken at label girdle.

Fig. 31. Above-ground parts of severely girdled *I. opaca.*

Nevertheless, there are disadvantages as well. Two years ago new labels were attached to a number of specimens of *Ilex opaca*. Some were tighter than others, but this remarkable plant began to engulf even the loose ones (Fig. 28). In a short time several wires were entrenched (Fig. 29). In March of this year a strong wind broke the top from a fine specimen of 'Aalto' No. 5 exactly at the label line (Fig. 30). Variety 'Judge Brown' suffered identical damage earlier. It is important to note that label girdling sufficient to cause breakage occurs so rapidly that there are no mineral deficiency symptoms in the tops that are typical of other types of girdling.

If *Ilex opaca* is so easily girdled by wire, is it subject also to root girdling? According to a prominent nurseryman in the area this is indeed the case with container grown stock.

Typical severe symptoms of girdling roots are pictured in Figure 31. The leaves are small, scant, and chlorotic. There is extensive dieback. A mass of roots and healed-over sprout stubs is visible at the base (Fig. 32).

Prevention of Injury

Much can be done to reduce the hazard of injury to holly. 1. Plant Selection. Do not buy stock that has been container grown more than two years. 2. Site selection. Although there are different views expressed regarding the exposure of holly to morning or afternoon sun (5, 6) protected sites that provide the needed well drained soils are preferred to poorly drained wind swept areas. 3. Careful planting. Plant in spring or autumn (spring preferred) into a hole that was dug a foot deeper and a foot wider than the ball. Allow no root or top drying before planting. Hume recommends a backfill mixture consisting of equal parts of moist peat, top soil, sand, and manure in such quantity that the surface of the ball is at or near the original surface of the soil. 4. Careful labeling. Attach labels very loosely to side branches. 5. Weed control. Prevent development of twining weeds such as bindweed and honeysuckle. 6. Snow removal. Carefully remove heavy snow before breakage occurs. 7. Look to the future. Will there be varieties available with stronger wood? Again we must admit that *Ilex opaca* is the plant of many contrasts. We know that the species is extremely variable. There are varieties with nearly spineless or very spiny leaves, yellow berries or red berries. And, in the literature, there are comments like this one (10): "Hollies will stand windy locations; many here on Cape Cod went through two hurricanes unprotected. They are a fine shore tree, as salt spray and salt water flooding do not injure them; in one of the hurricanes some trees were flooded to a depth of 20 feet, and they are still growing splendidly."

Perhaps old trees are sturdier than young ones. Perhaps also, in the mosaic of different heredities that makes up this remarkable, widely distributed native plant species, there is a source of breeding material with storm resistant wood.

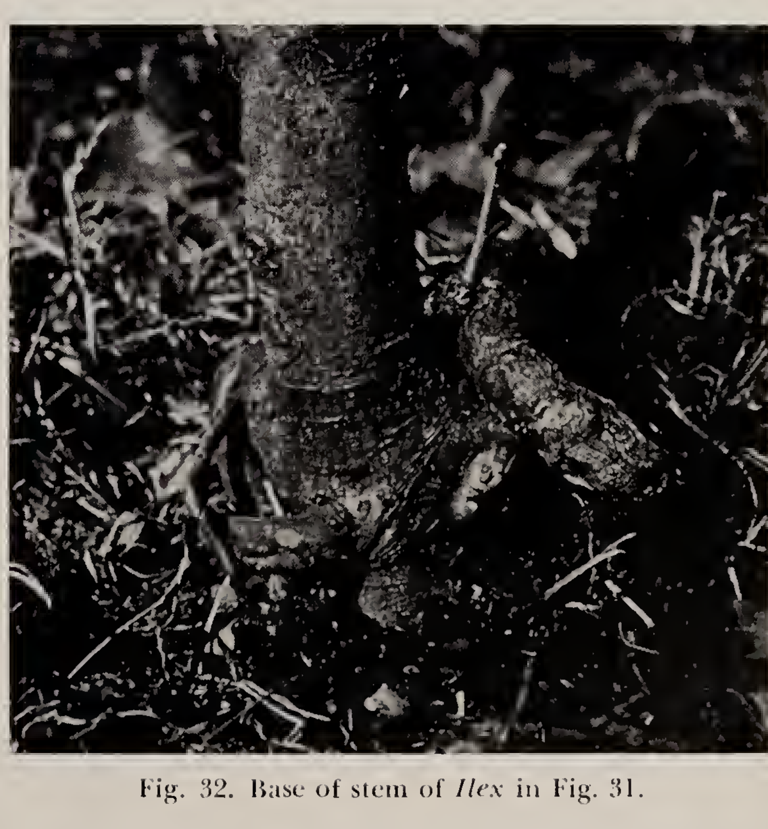

Fig. 32. Base of stem of *Ilex* in Fig. 31.

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Associates' Corner

It may have been a long winter for some people, but not for the Advisory Council.

We have formed several Committees to assist in the activities of the Arboretum, all of whom have enthusiastically put their shoulders to the wheel to such an extent that things are really spinning.

The Fernery Committee consisting of Mrs. Frederic L. Ballard, Jr., Mr. Carl Fenninger and Mrs. Arthur E. Newbold, III, have checked and listed the contents of that building and come up with several constructive ideas for the future.

The Committee on Hedges, led by Mrs. Newbold Taylor and Mr. Richard T. Nalle have had several meetings and are working on material in their department.

The Rock Wall Committee under the leadership of Mrs. John F. McCloskey has proved most popular, boasting quite a large membership of Mrs. Carl Anderson, Mrs. Thomas Atherton, Mr. Philp Cooney, Mrs. Gordon Crouter, Mrs. Arthur Rosenlund, Mrs. Albert Weymann and Mrs. Edwin Van Sciver. It is always a pleasure to work with Mrs. McCloskey, but I have a suspicion that not having to stoop to work on a wall may have a bearing on the above lady's choice of this committee.

Speaking of stooping, you really cannot get lower than Ground Covers, but here again we have an exceptional membership of knowledgeable horticulturists, led by Mrs. Frederic Rosengarten with the following co-horts, Mrs. Charles Platt, Mrs. John Gilpin, Mr. Richard H. L. Sexton and Mrs. Ralph Starr.

Dr. Edgar T. Wherry offered his valuable collection of Phlox to the Arboretum. This was promptly accepted and Mrs. Morris Cheston and Dr. J. J. Willaman, were appointed as a Phlox Garden Committee to work with Dr. Wherry in the construction of a rock wall to accommodate these plants.

Mrs. Edward F. R. Wood, Mrs. J. A. McCurdy and Mrs. Florens Rivinus have listed the present Vine collection and are making a survey of interesting future additions.

The Medicinal Garden has been placed in the capable hands of Mrs. Frederick W. Morris, III, and Mrs. Edmond G. Thomas.

Mr. Lloyd M. Coate's Membership Committee is also showing happy results.

Last, but far from least, the Publications Committee sparked by Mr. Caspar W. Haines is a gifted one consisting, as it does, of Dr. Henry M. Drinker, Mrs. Joseph P. Flanagan, Mr. E. Perot Walker and Mrs. Arthur E. Newbold, III.

The Arboretum is fortunate in having such outstanding talent to call upon among our membership and, if you are not already proud of being an Associate you soon will be, for stimulating things are happening at the Arboretum. You had better come see for yourself and bring a possible new member with you.

Marion W. Rivinus

The Medicinal Garden

II. The Glycoside Plants

John Dourley[1]

This article will deal specifically with the more important glycoside-bearing plants in our drug plant collection.

The actual function of glycosides in plants is somewhat obscure, but the physiological actions of many are well established, and it is to the presence of such compounds that many plants owe their therapeutic value. The most important group is that of the cardiac or sterol glycosides, and while these are not too widely distributed in plants, they occur principally in such families as the Liliaceae, Apocynaceae and Scrophulariaceae.

Cardiac Glycosides

LILIACEAE. Lily Family

Urginea maritima (L.) Baker. This is the plant which is frequently referred to in commerce as white squill. It is a bulbous species indigenous to Southern Europe. Squill consists of the dried fleshy inner scales of the bulb which contain several active glycosides. The first recorded mention of squill as a drug was made in the writings of Epimenides in the seventh century B.C. Pliny was conversant with it as he knew the two varieties, while Dioscordies described the method of making vinegar of squills. It is interesting to note that this ancient medicine has passed through the centuries with little change made in its preparation, e.g. Squill Vinegar, NF. The effect of squill on the heart in appropriate doses is similar to that of digitalis, it also acts as an expectorant by means of its irritating effect on the bronchial mucus membrane; it is, therefore, used in the treatment of chronic bronchitis. Preparations are Squill Syrup NF and Squill Fluid Extract NF.

APOCYNACEAE. Dogbane Family

Strophanthus Kombe Oliver is a native of Eastern Tropical Africa, usually found growing in abundance in forests along the Shire River. The genus consists of many attractive woody vines. The seed of this particular species is referred to in commerce as green strophanthus, and appears to have preference here in the United States, much of it being exported from Portuguese East Africa. It is from the dried ripe seed of the plant that the drug is obtained. The seed of *Strophanthus* has long been used by the African natives as a preparation for arrow poisons: no doubt it was this use that aroused the curiosity of Dr. Livingstone who in 1861 brought it to the attention of the medical world. *Strophanthus* and strophanthus tincture are no longer official in the United States, because of the unpleasant after effects, but the constituent strophanthin NF is used intravenously in emergencies for its effect on the heart. Strophanthin is extremely poisonous.

Acokanthera Schimperi Don. This species ranges from Abyssinia throughout West Africa. It is from the wood of this tree that the glycoside ouabain is extracted. There is little doubt that the natives of Africa also found employment for this tree in the preparations of ordeal and arrow poisons. The drug is used intravenously in emergencies for its cardiac effects, although its cardiotonic action is similar to that of other drugs. Ouabain U.S.P. Ouabain Injection U.S.P.

Thevetia nerifolia Juss. South America. This shrub when in flower is an attractive addition to the medicinal garden, but the plant has not been used to any great extent in medicine owing to its poisonous properties; tincture of the bark has been used quite successfully as an antiperiodic.

SCROPHULARIACEAE. Figwort Family

Digitalis purpurea L. Europe. The foxglove is a plant worthy of a place in any woodland garden, and the drug digitalis is derived from the dried or powdered leaves of this attractive species. The first of the cardiac stimulants introduced into medicine, it can still be considered the most important heart drug ever discovered. It has been said that the Welsh used the foxglove as an external remedy in the mid seventeenth century, but it was not until 1785 that Doctor William Withering, an English physician, first introduced it into medical practice. Since then it has found its way into every edition of the official compendia. Digitalis is quite extensively cultivated in the U.S.A., particularly in Minnesota where it is well adapted to soil and climatic conditions of that area, although considerable quantities are still imported from England and Germany.

[1]This is the second of a series of articles dealing with the plants in the Arboretum's Medicinal Garden.

The drug digitalis is used mainly for its effect on the cardiovascular system, it slows the heart rate and reduces cardiac edema with diuresis. The drug is also a myocardial stimulant in congestive heart failure, its most important effect, however, is in auricular fibrillation. Digitalis is also used to increase the coagulability of blood and to antagonise the anti-coagulant action of heparin in the body.

Preparations include powdered digitalis U.S.P., digitalis capsules, U.S.P. and digitalis tablets U.S.P. Many proprietary products containing digitalis extracts as well as glycoside mixtures are on the market e.g. Digitaline, Digalen, Digitora, etc. Digitoxin is a cardiotonic glycoside obtained from *D. purpurea*. This drug comes in tablet form or is administered by injection, there are several proprietary brands containing Digitoxin.

Digitalis lanata Ehrh. Southern Europe, often referred to as the Grecian Foxglove is another important species of this genus. The leaves produce the characteristic physiological effects of digitalis, although it is reported that the effect is considerably stronger and less cumulative. The two glycosides obtained from the leaves of this plant are Digoxin and Lanatocide — C. There are several proprietary preparations containing this drug on the market, to name two: Cedilanid and Digilanid.

Digicorin is a comparatively new drug obtained from the leaves of both *D. purpurea* and *D. lanata*, and, according to reports, it is a cardiotonic which possesses the curative action of digitalis as distinct from better known glycosides which are largely cardiotoxic.

Digitalis lutea L. Western United States. This species is considered therapeutically as good as *D. purpurea;* in point of fact it has the reputation of having much less toxic effects on the gastro-intestinal tract.

Miscellaneous Glycosides

LILIACEAE. Lily Family

Aloe vera L. var. *officinalis* Baker. Although a native of Asia, this is usually referred to in commerce as Curaçao or Barbados Aloes. The United States is possibly one of the larger importers of aloes, supplies coming principally from the West Indies, South Africa (Cape Aloes) and East Africa (Socotrine or Zanzibar Aloes). Aloes are described officially as, "The liquid evaporated to dryness which drains from the leaves of these plants." The drugs Aloe U.S.P. and Aloin NF (the active principal) are used as laxatives or cathartics, generally administered in pill form combined with anodynes and carminatives. The drug is also used as an emmenagogue and anthelmintic.

Fig. 33. A corner in the Medicinal Garden.

Alophen is a well known proprietary; it contains, in pill or capsule form, aloin and belladonna extract, used as a laxative.

POLYGONACEAE. Buckwheat Family

Rheum palmatum L. Rhubarb is indigenous to Central and Western China. The drug is derived from the dried rhizome and roots of the plant and is a source of cathartic drugs in Western Medicine. China is the main source of supply and rhubarb grown in the province of Shensi is considered of a very high quality. It is interesting to note that rhubarb has been used in medicine in China for over 4,700 years, since it was described in the early Chinese work on Materia Medica called 'Shen-Nung-Pentsao-King'. Today Rhubarb NF and its preparations are still used as mild laxatives. It is commonly used in the ailments of children and is practically a standard nursery remedy.

LEGUMINOSAE. Pea Family

Cassia angustifolia Vahl. Known in commerce as Indian or Tinnevelly Senna, Cassia is cultivated in India and the Sudan. Senna (senna leaves) consists of the dried leaflets, although the seed pods contain the same active principal. This drug has been known to the Arabs for many centuries, and is believed to have been introduced into Western medicine by them. Senna is valued in medicine for its cathartic properties. Senna NF used in the form of tea, Senna Powder NF — also known as compound licorice powder, while glysennid is a proprietary preparation containing the active principal.

RUTACEAE. Rue Family

Ruta graveolens L. Synonyms: Rue Ave-grace. The plant is a native of Southern Europe and has been used in medicine for many centuries. It was mentioned by Dioscorides and once in the Scriptures — St. Luke XI. 42.

As a point of interest, "Rue was believed to possess the merits of dispelling infection and to this day the old custom of strewing the courts with herbs (of which Rue is an ingredient) is maintained. It was also used in the exorcisms ordained by the Roman Catholic Church, hence the synonym Ave-grace." (Potter's New Cyclopedia of Botanical Drugs and Preparations.) The herb was used medicinally as a stimulant, antispasmodic and emmenagogue. In medicine today rutin is the well known glycoside derived from this herb, and is used in the treatment of correcting capillary fragility and other hemorrhagic conditions. It is thought that rutin may play an important role in the treatment of the after effects of exposure to atomic radiation.

Casimiroa edulis Llave & Lex. Pharmacologists of late have been most interested in the therapeutic qualities of this plan; the bark, leaves and especially the seed contain a glycoside that has a hypnotic and sedative effect upon cerebral centers. It also appears to have potential anti-hypersensitive qualities.

RHAMNACEAE. Buckthorn Family

Rhamnus Purshiana DC. Chitten Bark is indigenous to the Pacific Northwest from California to British Columbia. Cascara sagrada is the air-dried bark of this species. When the bark is collected it is necessary for it to remain in storage for at least one year; this apparently is to complete the enzymatic decomposition of an emetic principal present in the fresh bark. Cascara sagrada is possibly the most widely used of all cathartic drugs. There are numerous preparations on the market, e.g. Cascara Extract Tablets NF, Aromatic cascara sagrada fluid extract U.S.P. Cascara is also found in such products as Cas Evac, etc.

Rhamnus Frangula L. Europe. The Buckthorn Bark. Frangula is the dried bark of this species; the process of drying is more or less the same as described above. Frangula is used in Europe in much the same way as cascara sagrada is used here in the United States.

UMBELLIFERAE. Parsley Family

Ammi visnaga Lam. North Africa. This little plant has been used by Arabic people for many years and was commonly referred to as Knella. The local physicians often prescribed a dried concoction of the seed as a diuretic and as an antispasmodic in renal colic. A number of years ago research workers discovered that the active constituent of the seed was Knellin, which they found to be an effective vasodilator with a selective action on the coronary arteries. Today Knellin has become invaluable in the treatment of Angina pectoris and as an anti-spasmodic in bronchial asthma. There are a number of proprietary Knellin products, e.g. Eskel (Smith, Kline and French) Knelloyd (Lloyd Brothers Pharmacists) .

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Arboretum Activities

(*Continued from Page 22*)

On Friday afternoon, May 18, Dr. Boughey gave an illustrated lecture on "Game Animals and Vegetation" to an audience composed of Associates of the Arboretum and their friends. This lecture was based on the speaker's intimate knowledge of the relationship which exists between the game animals of South Africa and the plant life which provides them with both food and shelter.

Spring Planting

It has often been stated in these pages that the autumn months are the ones during which most of our planting activity takes place. Although this is certainly the case, it happened that the Spring of 1962 offered a combination of circumstances which favored the moving of plants from lath house, cold frame and nursery to their per-

manent positions on the grounds. The result has been an unprecedented wave of spring transplanting. The following are just a few of the groups which have been involved.

Magnolias. More than forty plants have been set out on the north slope which has been selected as the major area of concentration for these handsome trees. A half dozen others have been moved to a secondary Magnolia grouping along Hillcrest Avenue.

Stewartias. A site below the Rose Garden has been selected for this group of attractive American and Oriental trees and shrubs. We now have all seven species of *Stewartia* known to be hardy in the Philadelphia area and have supplemented this planting by adding such other members of the Theaceae or Tea family as *Franklinia* and *Cleyera*.

Tamarisks. These graceful, feathery plants with their delicately colored flowers deserve a place in any collection of ornamental shrubs. We now have a fairly representative collection along the lower roadway across from the native azalea area.

Crab Apples. Some fifty specimens of crab apples have been added to our growing collection of *Malus*. Most of these have been planted on the farm area where they will provide a mass show of color from Northwestern Avenue. Others have been set out on the south slope below the Rose Garden.

J. M. F., Jr.

Publications by Members of the Staff

The following books by members of the Staff of the Morris Arboretum are available at reduced prices to Associates:

Wherry, E. T. *The Genus Phlox*. Morris Arboretum Monographs III. 174 pages. Illust. Philadelphia 1955. $4.00. Price to Associates, $3.00

Wherry, E. T. *Wild Flower Guide,* 202 pages. 106 plates. New York 1948. $3.50. Price to Associates, $3.00

Wherry, E. T. *Guide to Eastern Ferns*. 318 pages. Illust. Doubleday 1937. $4.00. Price to Associates, $3.00

Li, H. L. *Chinese Flower Arrangement*. 122 pages. 10 figs. 20 plates. Philadelphia 1956. $4.00. Price to Associates, $3.50

Fogg, J. M., Jr. *Weeds of Lawn and Garden*. 215 pages. 176 figs. Philadelphia 1945. $3.00. Price to Associates, $2.50

Please send orders and remittances to:

The Associates of the Morris Arboretum

The Morris Arboretum

9414 Meadowbrook Avenue

Philadelphia 18, Pa.

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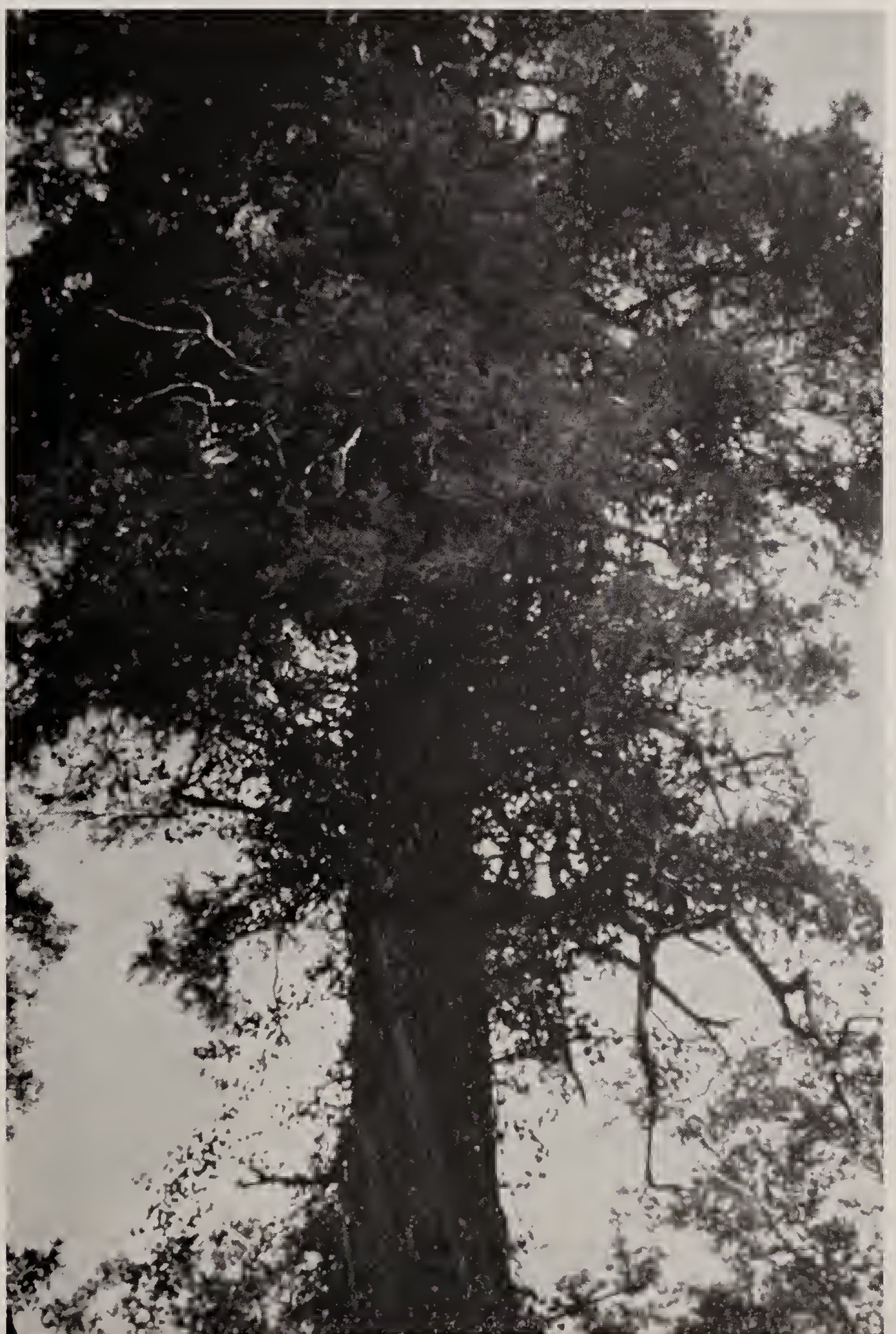

Chamaecyparis Henryae

Published by
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THE MORRIS ARBORETUM

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Arboretum Activities

The Staff

The Director attended the meetings of the American Association of Botanical Gardens and Arboretums which were held at Wooster, Ohio, May 31 and June 1 and 2. On June 12 he delivered a paper on "Methods of Plant Identification" at the third annual meeting of the American Society of Pharmacognosy which took place at Morgantown, West Virginia.

On August 10 the Director and his wife left for Europe where they visited botanical gardens and arboretums in Norway, Sweden, Denmark and Holland before attending the 16th International Horticultural Congress held in Brussels from August 31 to September 9.

On June 16 and 17 Dr. Li attended the third annual meetings of the American Society for Economic Botany which took place in Washington, D. C.

From August 24 to 31 Dr. Allison participated in the sessions of the American Phytopathological Society which were held at Corvallis, Oregon, in conjunction with the annual meeting of the American Institute of Biological Sciences. She read a paper entitled, "The influence of conidial matrix on the behavior of *Colletotrichum gloeosporioides* and *Stilbella* sp."

Mr. John Dourley represented the Arboretum at the annual meetings of the National Associa-

(*Continued on Page 50*)

A New Species of Chamaecyparis

Hui-Lin Li

The white cedar of eastern North America has long been considered to be one species, *Chamaecyparis thyoides* (L.) B.S.P. It inhabits the cold swamps of the Atlantic and Gulf coast plains ranging widely from southern Maine in the north to northern Florida westward to southern Alabama and Mississippi in the south (Korstian & Brush, Southern White Cedar, U.S.D.A. Tech. Bull, No. 251. 1931). A very complete botanical description is given in Sargent, Silva of North America 10: 111. 1896.

Field and herbarium studies have shown that the southern tree, occurring along the Gulf coast plains, appears to be quite distinct, in both general habit as well as detailed features, from the northern and mid-Atlantic tree. As the original species was established by Linnaeus from a northern type, the southern white cedar is here proposed as representing a new species. The description follows:

Chamaecyparis Henryae, sp. nov.

Arbor sempervirens dense foliata, ad 28 m. alta; foliis squamaeformis adnato-decurrentis, flavo-viridibus, conspicue glandulosis vel eglandulosis, triangularo-ovatis, 2-3 mm. longis, apice acutis incurvatis; foliis juvenilis linearo-lanceolatis, utrinque viridibus, haud glaucis; floribus staminibus fusco-stramineis; strobilus subglobosis, circiter 4-5 mm. longis, olivaceis vel stramineis, haud glaucis; squamis 5, coriaceis, suborbicularibus, 3-5 mm. diametro, margine inconspicue denticulatis; seminibus rotundatis, fusco-brunneis, cum alis circiter 3 mm. diametro, alis utrinque sinuatis.

Tree to 28 m. tall, the trunk 1.5 m. in diameter; bark light reddish brown, irregularly and shallowly fissured into flat connected ridges spirally twisted around the stem; branches slender, bright green, compressed at the tip, becoming angular and then terete, more or less irregularly arranged. Leaves light yellowish green, becoming dark green on older trees, the lateral pairs conduplicate, with appressed incurved acute tips, the facial pairs appressed, ovate-triangular, acute, keeled, about 2-3 mm. long; leaves of the main axes marked on the back with a conspicuous resinous gland, those of the lateral branches generally eglandular; juvenile leaves on seedling plants linear-lanceolate, acuminate, 6-7 mm. long, green on both surfaces, not glaucous beneath. Staminate flowers globose to oblong-globose, more or less 4-sided, about 2 mm. long, with 4-6 pairs of stamens, the scales rounded, dark stramineous, the pollen-sacs 2. Cones subglobose, 4-sided, about 5 mm. long, olive green to stramineous, not glaucous or very slightly glaucous; scales 5, suborbicular, 3-5 mm. across, the edge irregularly denticulate and ciliate at first, each with an

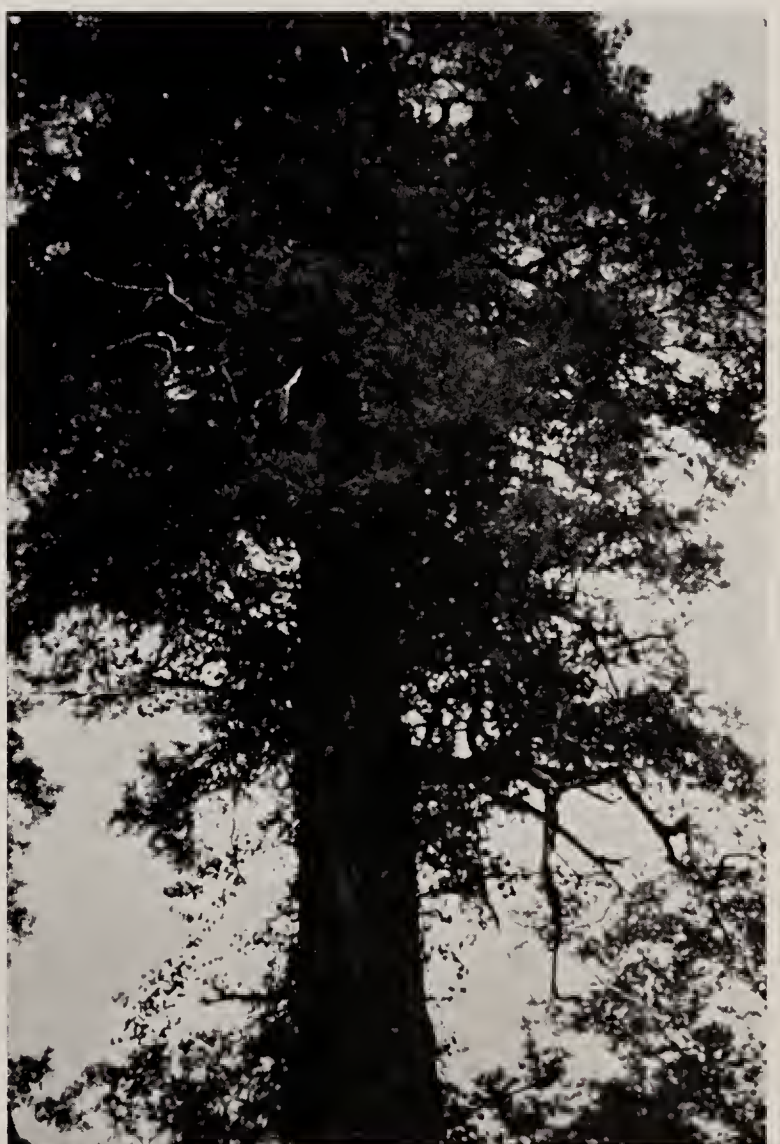

Fig. 34. *Chamaecyparis Henryae,* upper half of the big tree.

Fig. 35. *Chamaecyparis Henryae,* trunk of the big tree.

ovate acute central boss; seeds 1-3 to each scale, dark brown, 3 mm. long and broad with wings, the wings broad, prominent, about as broad as the seed proper.

COLLECTIONS EXAMINED: (C= University of California, Berkeley; M= Morris Arboretum; P= Academy of Natural Sciences, Philadelphia.)

FLORIDA: Okaloosa County: N. W. of Ft. Walton, *M. G. Henry 1824,* Nov. 1939 (C, P); Calliver, *J. B. McFarlin 11387,* Nov. 7, 1937 (M); W. of Milligan, *M. G. Henry 18,* Aug. 28, 1962 (M, P); N. of Niceville, *M. G. Henry 19,* Aug. 28, 1962 (M, P); E. of Niceville, *M. G. Henry 20,* Aug. 30, 1962 (M, P). Santa Rosa County: Yellow River Swamp, S. of Milton, *M. G. Henry 1830,* Nov. 1939 (M, P); N. of Milton, *M. G. Henry 6759,* Nov. 3, 1959 (M, P); S. of Blackwater River, Milton, *M. G. Henry s. n.,* August 19, 1962 (M, P); N. of Milton, *M. G. Henry 3,* Aug. 19, 1962 (M, P); N. W. of Milton, *M. G. Henry 5,* Aug. 21, 1962 (M, P). Escambia County: Marcus Creek, W. of Pensacola, *Godfrey 54595,* 1956 (C); N. E. of Flomaton, *M. G. Henry 4,* Aug. 19, 1962 (M, P); E. of Quintette, *M. G. Henry 22,* Aug. 30, 1962 (M, P); Perdido River at Barineau Park, *M. G. Henry 23,* Aug. 30, 1962 (M, isotype, P, holotype).

ALABAMA: Escambia County: N. of Flomaton, *M. G. Henry 9,* August 22, 1962 (M, P); N. E. of Robinsonville, *M. G. Henry 10,* Aug. 22, 1962 (M, P); N. W. of Flomaton, *M. G. Henry 14, 15,* Aug. 23, 1962 (M, P); N. E. of Robinsonville, *M. G. Henry 24,* Aug. 30, 1962 (M, P); Intersection of R27 and R17, *M. G. Henry 27* (M, P); E. of Brenton, *M. G. Henry 28,* Sept. 1, 1962 (M, P). Baldwin County: Perdido River Swamp, N. W. of Muscogee, *M. G. Henry 7,* Aug. 21, 1962 (M, P).

MISSISSIPPI: Jackson County: S. of Vancleave, *M. G. Henry 17,* Aug. 27, 1962 (M, P).

A tree, generally to 30-60 feet, sometimes to 89 feet, along creeks, moist streams and river banks and in swamps, sandy or peaty soil, with *Pinus Taeda, Taxodium, Ilex opaca, Cyrilla racemiflora, Clethra alnifolia,* etc.

This species is named after the collector, Mrs. J. Nórman (Mary G.) Henry (Gladwyne, Pennsylvania), who has contributed much to our knowledge on the southeastern flora.

Mrs. Henry first collected this tree over twenty years ago and has noted since the very beginning the distinctness of the tree from its supposed northern compatriots. In more recent years she has made several special expeditions to collect and study this tree in the field and has succeeded in locating it in many previously uncollected localities including one with one of the largest specimens on record. (Figs. 34-37).

In general habit this tree differs from the northern *C. thyoides* in its smoother bark with

Fig. 36. *Chamaecyparis Henryae,* basal portion of the big tree.

Fig. 37. *Chamaecyparis Henryae*, trees along sandy banks of upper Escambia River, Alabama.

the markings consistently twisting on the trunks (Figs. 34-36), the less flattened branchlets, and the much lighter colored, yellowish green foliage, especially pronounced on younger specimens. The leaves differ also in being slightly larger (2-3 mm. long), more appressed to the stem with the apex not generally spreading as in *C. thyoides*. The leaves on the main axes are prominently glandular while the others are mostly eglandular. The facial leaves are generally distinctly keeled. In *C. thyoides* the leaves are generally glandular throughout and less keeled. In the juvenile leaves, the lower surfaces are green and not glaucous in this new species while there are two distinct white bands in the northern species.

The staminate flowers are pale in color while in *C. thyoides* they are dark brown or nearly blackish. The cones are slightly larger, generally with 5 instead of 6 scales and are lighter colored and without the white bloom or are only very slightly glaucous (Fig. 38). The seeds are larger and with two broader more prominent wings.

The cones mature in the fall but the staminate flowers are observed to appear in early November, as in the collections *Henry 1830* and *6759* cited above. Staminate flowers are noted on collections of *C. thyoides* only in the spring and only very rarely in early autumn. Chapman, Flora of Southern United States, 2nd ed. 1883, gives the date of flowering as "April", which is thus applicable only to carpellate flowers and not to the staminate ones.

In general characters, this new species indicates a somewhat closer relationship with the western *Chamaecyparis nootkatensis* (Lamb.) Spach than when compared with *C. thyoides*. It is noteworthy that the general region in which this new species occurs is one which yields a number of relic conifer species such as *Taxus floridana* Chapman, *Torreya taxifolia* Arn., *Taxodium ascendens* Brongn. and *Pinus palustris* Mill. as well as other endemic species of flowering plants such as *Lilium iridollae* M. G. Henry and *Hymenocallis Henryae* Traub, also discovered by Mrs. Henry.

It is also of interest to note that as early as 1759 John Bartram noted that the southern white cedar is different from the one in the north. In northern Baldwin County, Alabama, Bartram recorded that "On passing by a swamp at the head of a bay or lagoon of the river, I observed a species of Cypress, it differs a little from the White Cedar of New Jersey and Pennsylvania the trunk is short and the limbs spreading horizontally, the branches fuller of leaves and the cones larger and of a crimson or reddish purple color when ripe." (Bartram's Travel, 1759, p. 411, Harper's edition, 1958, p. 210).

The species grows in swampy places in moist sandy peaty soils. It is common especially east of the Mobile Bay and along the Escambia and Perdido Rivers (Fig. 37). The northernmost station, as noted by Mrs. Henry, is along the northern limit of Escambia County, Alabama. In the west, it is apparently very scarce in Mississippi, as it was noted only once by Mrs. Henry on a 800 mile trip. It has been collected in the east in Okaloosa County, Florida, but its actual range in the east and northeast may have to be ascertained by further exploration.

The largest specimen, *Henry 14*, located at 10 miles north and 6 miles west of Flomaton, Alabama, measured 89 feet high with a trunk diameter of 5 feet 1 in. at 4½ feet height. It is 32 feet to the first live limb and has a crown spread of 33 feet (Figs. 34-36). *Chamaecyparis thyoides* is generally depicted as attaining a height of about 50 feet in Maine and about 75 feet in the south. Korstian & Brush (1931) noted that on good sites dominant trees in mature stands vary from 70 to 100 feet in height. Mayr (Waldungen Nord-Amer. 193. 1890) found the average size of trees growing on white sandy soil in Alabama to be 86 feet in height and 2 feet

Fig. 38. Cones of *Chamaecyparis Henryae;* right, side-view, unopened; left, top-view, opened. × 2.

in diameter. Such large trees are now extremely rare. Extensive logging has greatly reduced the number of stands and large specimens. This giant tree has apparently been saved from the woodcutter's axe because it is slightly crooked.

The wood of this species is near-white, fine-grained and pleasantly aromatic. It is very durable in contact with water and it does not warp, split or crack even when nails are driven in the ends of boards. It is the preferred wood for building boats and also houses, although it is now becoming very scarce owing to extensive lumbering. Locally the tree is known as "Juniper" or "Swamp Juniper." The above information as well as measurements of the big tree are kindly furnished by Mr. M. C. Leach of Florida. He also reports that trees about 75 feet tall are not rare and that he has seen a number of younger trees with lesser trunk diameter and about 100 feet tall.

This species seems to be hardy in the Philadelphia area. Four young trees have been growing in Gladwyne, Pennsylvania since 1955 with no protection. The tallest of these is now 7 feet.

Associates' Corner

Did you know that we Associates now have our own bulletin board?

It is an artistic, fluorescent-lighted affair, located in the lobby of the Gates Building to the right of the entrance, and it keeps us informed as to what is going on in the Arboretum which is of special interest to us.

Here is the place to look for notices of lectures, such as the course on Plant Ecology offered by Dr. Wherry last Spring and the fine lecture on "Game Animals and Vegetation" given in May by Dr. Arthur S. Boughey, Professor of Botany at the University of Southern Rhodesia and Nyassaland.

Such events are, of course, announced in the pages of the Bulletin, as well as by mailed notices, but the bulletin board is usually the place where they first appear and it will pay us to keep watching it.

Since the board is a commodious one, it lends itself to a diversity of uses. One interesting exhibit, which is most appropriate in connection with our Medicinal Garden, is a replica of a clay tablet recording three prescriptions used by a Sumerian physician in 2100 B.C.[1]

To brighten up one corner there is a changing exhibit of botanical subjects on postage stamps prepared by Mrs. Fogg, who is an ardent philatelist. It may be Hungary one week, followed by Switzerland, Japan, Belgian Congo, and so on.

During the summer course on Woody Plants a section of the board was devoted to a daily exhibit of books and articles which were of timely interest to members of the class. These frequently consisted of articles from our own Bulletin dealing with the plant group or groups which the class was studying on that particular day.

The members of the staff are doing some fascinating work, including intricate photography, the results of which are worthy of display. Don't miss these opportunities; you will be amply rewarded!

Marion W. Rivinus

[1] Editor's Note: This tablet is a gift from Mrs. Rivinus.

Deciduous Magnolias of Californian Origin

D. Todd Gresham

A poll of magnolia growers would probably designate *M. Campbellii* as the most coveted species in cultivation. Unfortunately, certain peculiarities of this beautiful flowering tree preclude the possibility of its attaining this ambition.

Firstly, it is one of the most tender magnolias in cultivation, 15° to 20° F. will damage the buds, and lower temperature may kill the tree. Growers in favored parts of Zones 9 and 10 must remain the most likely to succeed. Then, too, the time required for bloom, either from graft or seed, is from 10 to 25 years. Bulldozers and real estate developers, with their absolute disregard for a thing of beauty, do not encourage this present-day gamble.

For me, the most compelling attraction of *M. Campbellii* is its coloring. From the deep crimson forms, through rose pink, to blush and white, I find that the pure, vibrant coloring excites my senses. Actually this Alizarin Crimson is one of the most primitive colors, found in many ancient plant groups, e.g., Hellebores, Heather, Sarracenia, Cercis, Arums, Orchids, etc.

In the Spring of 1955, the thought occurred to me that in *M. Veitchii,* the purity of the red violet coloring of *M. Campbellii* had been sufficiently dominant to mask the blue-violet base of *M. denudata,* which is the pollen parent of *M. Veitchii.*

Selecting for hardiness a red and a white seed parent, *M. Veitchii* was crossed with *M. liliflora,* and *M. Lennei alba.* From these crosses over 100 seedlings were germinated and transplanted to gallon cans. At this stage I became appalled by the thought of caring for 100 magnolias for an undertermined number of years before flowering and offered them to local nurserymen. One disdainfully snorted, "They are seedlings and will probably never bloom."

After screening for habit of growth and leaf, 24 individuals of each cross were planted out from cans in sets of four, a practice now advocated for fruit culture. All grew with vigor into arborescent plants, the heavily lenticillate wood resembled *M. Veitchii;* the foliage large and ornamental, mostly oblanceolate, the apex sharply acuminate, with the upper surface glabrous as in *M. Veitchii,* giving a smooth waxy feel, in contrast to the rough pubescent leaf of the Soulangianas.

Gophers proved to be my worst enemy. They acquired a very special taste for the tangy roots, and seemed determined to block efforts to flower the trees. All parts of the magnolia appear to attract some form of wild life. The finch and sparrow families relish petals and foliage of several varieties; squirrels are partial to the gynoecium and matured seed; rabbits make merry with tender bark; snail and slug dine with epicurean delight on foliage, young bark and petals.

The first bloom appeared in the fall of 1960 on a *M. liliflora* × *M. Veitchii* individual I had named 'Dark Raiment' because of its very dark, coriaceous foliage, rivaled only by *M. Dawsoniana.* One other foliage character of this plant is of interest. The lower leaves, so far, show decided autumn coloring similar to Sassafras. Whether this is a fixed character, and would be even more evident in favorable climates, remains to be proven. The degree to date is pleasing, and I have never noted it in any other magnolia. The tree is very vigorous, with ascending branches, and many blossom spurs taking off at right angles to the branches.

'Dark Raiment's' first sickle-shaped bud was exceptionally long and slender, measuring 5½ inches (13.7 cm.) in length, of a deep, glowing red violet color. It is interesting to note that the bud on opening proved to have twelve slender 2 inch-(5.0 cm.) wide tepals (4-4-4). The outer eight formed a cup for a short period, and then reflexed below the flower base, the inner four remained in an upright position, clasping the gynoecium. The general effect was graceful and different.

A review of the characters of its parentage will show that there is a definite influence by *M. Campbellii,* the grandmother, as evidenced by the twelve tepals, eight reflexing at maturity, four upright with glowing red-violet coloring. *M. Veitchii* has contributed the high-standing bud; *M. liliflora* the sickle twist and depth of color. *M. Veitchii* flowers with nine tepals: *M. liliflora,* three sepals, six petals.

On 9 July 1961, the first of eight out-of-season blooms appeared. Unlike most summer and fall deciduous magnolia, the flowers of these were fully formed and as large as the normal spring blooms. In 1962 thirty flowers opened, commencing on February 28.

Fig. 39. *Magnolia* 'Royal Crown' showing crown points and inward roll.

Briefly, other individuals of this same cross, with their distinguishing characters, may be designated as follows:

'Royal Crown'. Dark red-violet flowers; twelve tepals, the outer four inheriting the inward roll of the outer petals of *M. liliflora,* giving the effect of a crown's upstanding points (Figs. 39 and 40) [1], the inner surface of the tepals marble-white; buds 5½ inches (13.7 cm.) high, 2 inches (5.0 cm.) wide. (Fig. 41).

'Vin Rouge'. Heavy textured dark wine-red flower. Worth growing for foliage; new growth glabrous, bonzy red. Close inspection reveals red veining, stipules blood-red.

'Raspberry Ice'. Red-violet base, shading evenly to white top; twelve tepals, rather campanulate in form, resembling *M. Veitchii* at maturity.

'Peppermint Stick'. Blue-violet base, flower white in effect, with a stripe of color centered on each tepal, and extending its full length. Inner tepals remain upright, while outer tepals reflex sharply.

[1] Figs. 39 and 40 by author; Figs. 41 and 42 by George Lee.

Differing in every respect from their svelte brunette companions are the progeny of the *M. Lennei alba* × *M. Veitchii* cross. These are buxom, full-bodied nordic blondes, their milk-white complexion tastefully enhanced by rouged accents. They are far more spectacular than the best Soulangiana whites and, within my knowledge, will compare favorably with good *M. Campbellii* and *M. mollicomata* white forms.

Individuals of this cross are remarkably uniform, and of consistent high quality. The type plant, 'Rouged Alabaster' showed color on the 14th of February 1962, when its dark brownish black, hirsute perule split. (Fig. 42). The largest of twelve flowers had a twelve inch (30.0 cm.) diameter, its great broadly spatulate petal being 6½ inches (16.2 cm.) long by 4½ inches (11.2 cm.) wide, of exceptionally heavy substance. Nine symmetrically arranged tepals (3-3-3) were constricted just above the base, then flared into a well-formed cup. The outer six tepals were pleasantly "rouged" *M. Campbellii* rose-pink from the base to approximately one half the height of tepal. The inner three tepals were similarly marked, but with a deeper, more intense coloring. The peduncle supporting the flower was very strong and villous with dense grey hair. The filaments were rose-red and the gynoecium green with straw-colored stigmas.

Other individuals of this cross are:

'Crimson Stipple'. A very vigorous grower which in time will make a large wide-spreading tree. It is distinguished by an unusual pattern of crimson pin-points, creating a very luminous pink glow, against the pure white background.

'Royal Flush' has the deepest-colored zone of all. The base of the inner tepals is as dark as *M. Veitchii* in a vintage year.

Fig. 40. *Magnolia* 'Royal Crown' showing reflexed position.

Fig. 41. *Magnolia* 'Royal Crown' in bud.

'Spring Rite', in which the general effect is white, with the faintest rose-pink base staining.

'Delicatissima' may prove a novelty for the small, confined garden, or even large tub. It is a very slight grower with small white campanulate flowers, stained with rose-pink.

'Sulphur Cockatoo' in which there appears to be a possible yellow character, very faint, it is true, but contrasted with the pure whites there is a warm coloring, most evident in the first buds. The darkest degree of this tint is to be found at base of outer three tepals. The inner six tepals are stained blue violet. The flower is very large, and reflexes to the horizontal at maturity.

Individuals of this cross exude a very pleasant and intense honey and lilac odor, comparing in strength with *M. Wilsonii* and *M. grandiflora*.

Following the pattern of Mr. G. H. Johnstone, in his excellent book "Asiatic Magnolias in Cultivation", these are common characters of both crosses:

M. liliflora × *M. Veitchii*

Tree deciduous, moderate grower, trunk grey, upright, ascending branches; branchlets of current year's growth green, becoming red-brown, heavily lenticellate. Winter buds pubescent.

Leaves as much as 8 inches (20.0 cm.) long, and 4½ inches (11.2 cm.) wide where broadest, though smaller towards base of shoot, oblanceolate, sharply acuminate at apex, base equally cuneate; upper surface glabrous, under surface glabrous, the leaves as they unfold are plum-red, length of time retaining this color variable, finally becoming green; petiole about 1 inch (2.5 cm.), red.

Flowers open in February, dark red violet to white, up to 11 inches (27.5 cm) when expanded; tepals 12, arranged (4-4-4), the largest 5½ inches (13.7 cm.) long by 2 inches (5.0 cm.) wide, slenderly spatulate, narrowed at base Gynoecium green, stigmas rose-colored. Filaments rose red. Peduncle ¾ inch, glabrous. Flower buds ovoid, green, pubescent with grey silvery hairs.

M. Lennei alba × *M. Veitchii*

Tree deciduous, vigorous grower, trunk grey, wide-spreading branches; branchlets of current year's growth green, becoming red-brown, heavily lenticellate. Winter buds pubescent.

Leaves oblanceolate, 8½ inches (21.2 cm.) long by 5 inches (12.5 cm.) wide where broadest, smaller towards base, sharply acuminate at apex, base equally, or unequally cuneate; upper sur-

Fig. 42. *Magnolia* 'Rouged Alabaster' buds and flowers in cup stage.

face glabrous, under surface pubescent along veins and around margin, as they unfold a bronzy green, becoming the light green associated with white flowers on maturing.

Flowers open in February, white with crimson rose-pink, or blue violet base, up to 12 inches (30.0 cm.) when fully expanded; tepals nine, arranged (3-3-3), the largest 6½ inches (16.2 cm.) long by 4½ inches (11.2 cm.) wide, broadly spatulate, narrowed at base. Gynoecium green, stigmas straw-colored. Filaments rose-red. Intense honey and lilac fragrance. Peduncle heavily villous with grey hairs. 'Crimson Stipple' shows a distinct pedicel.

Arboretum Activities

(*Continued from Page 42*)

tion of Gardeners at Boston, Mass., during the week of September 10.

The Summer Course

For the eighth successive year the Arboretum offered a six weeks graduate course on "Woody Plants" under the auspices of the Summer School of the University of Pennsylvania. The course was given by the Director, who for the fourth year had the able assistance of Mrs. Edith C. Gall.

About half the class of 21 students were high school teachers of biology who were in attendance as participants of the National Science Foundation's Summer Institute. Also enrolled were several graduate students from the University's Division of Landscape Architecture.

As in past years, the members of the class learned to identify, through laboratory and field studies, several hundred species of trees, shrubs and woody vines. Daily walks were taken around the Arboretum and visits were made to surrounding areas, including an all-day trip to the Pine Barrens of New Jersey. In addition to the regular lectures, specialized talks and demonstrations stressed the recognition and control of plant diseases and methods of plant propagation.

Recreation Area

The Arboretum's Picnic Grounds continue to attract faculty and student groups from the campus. Over 40 organizations scheduled outings here this year representing a total attendance of over 3500 persons.

J. M. F., Jr.

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since, June, 1962:

Mr. Milton Berger
Mr. Charles H. Brown
Mr. Lyman Clark
Mr. and Mrs. John E. Cornwell
Dr. A. Reynolds Crane
Mr. Wesley O. Doughty
Mrs. John E. Fletcher
Mr. James E. Foyle
Dr. Harry A. Kaplan
Mr. John V. Lovitt
Mrs. Evelyn Malerman
Mr. Paul McFarland
Mr. William M. Pye, Jr.
Mr. H. C. Randolph
Mr. Carl N. Roth
Mrs. Philip A. Schoettle
Mrs. James M. Skinner
Mr. J. Homer Smith
Mr. Wilbur N. Steltzer
Mrs. W. M. Stilwell, Jr.
Mrs. Leon Sunstein, Jr.
Mr. Robert B. Taylor
Mr. and Mrs. Charles J. Wehner

A Natural Hybrid between Pinus Griffithii and P. Parviflora

Frank S. Santamour, Jr.[1]

The Morris Arboretum annually handles thousands of plants in the greenhouse, in the nursery, and in permanent outplantings. With this volume of work, it is only natural that occasionally some segment of a plant's record and identification may be lost. Such is the case with the young pine pictured in Figure 43. When measured in February 1962 this tree was 18 years old, 30 feet tall, and 8.5 inches in diameter at breast height (4.5 feet above the ground). The identification tag on the tree read ,"M 47-322, *Pinus koraiensis?* Record Lost."

This tree first attracted the writer's attention in the fall of 1961, when after a temporary suspension of hybridization work, suitable parent material was being sought for the next spring's breeding. An examination of the cones, seeds, and needle anatomy revealed that the specimen was definitely not *P. koraiensis* Sieb. and Zucc. (Korean white pine). Further study showed that the tree could not be assigned to any species of white pine, and the tentative conclusion was that it must be of hybrid origin. Because of its proximity to an ill-fated statue of Mercury on the grounds of the Morris Arboretum, the tree was dubbed the "Mercury pine," and the name will be used throughout this paper.

Characteristics of the Hybrid

The characteristics of the putative hybrid are as follows:

Branchlets greenish-brown, puberulous; buds acute, bud scales appressed, slightly resinous; leaves slender, straight, 10-16 cm. long, serrulate, resin ducts 2, dorsal and external; stomata ventral only, 3 to 5 rows; female conelet red when young, subterminal or pseudolateral, peduncle 15-30 mm. long; mature cone persistent, 9-15 cm. long, conic-oblong, sometimes curved, scales convex, lateral margins somewhat revolute; seed about 1 cm. long, seed coat thick, wing attached to seed, and about same length as seed.

[1] Geneticist, Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The Experiment Station's forest genetics research is conducted in cooperation with the Morris Arboretum of the University of Pennsylvania, Philadelphia, Pennsylvania.

Determination of Parentage

A summary of all reported natural and artificial hybrids in the five-needled white pines was made by Wright (1959); and while it is possible that many other hybrid combinations are possible, his summary provides the best present guide to crossabilities. The presence of the seed wing effectively eliminated from consideration any possible hybrids between species in the groups *Flexiles* and *Cembrae,* in which all species have wingless seed. There remained, however, the possibility that one parent of the hybrid belonged to either of these groups, with the other parent in the group *Strobi.*

Stone and Duffield (1950) reported on a few artificial 1-year-old hybrids between sugar pine (*P. Lambertiana* Dougl.) and Armand pine (*P. Armandi* Franch.), and between sugar pine and Korean white pine. These plants were raised through embryo culture because standard methods of germination had failed with similar seedlots. Fascicles of needles produced the first year lacked the dorsal stomata characteristic of sugar pine. Dr. William B. Critchfield (personal communication) recently stated that the needles of these young trees still posses no dorsal stomata, and also that several seed from more recent crossings of *P. Lambertiana* × *Armandi* germinated without special treatment. I recently examined young hybrids of *P. Armandi* × *Lambertiana* made by Albert G. Johnson while he was at the Arnold Arboretum. These hybrids have 1 to 2 rows of dorsal stomata.

The hybrids discussed above can be eliminated from consideration under the assumptions that (1) artificial (arboretum) conditions favoring such crosses are rather limited, (2) normal seed germination techniques may not be successful, (3) sugar pine itself is not particularly well adapted to the Philadelphia area. Furthermore, the cone and seed size of the Mercury pine is less than would be expected from these crosses.

The only other combinations involving species from two groups are *P. flexilis* James × *P. Griffithii* McClel. (limber × Himalayan white), *P. strobus* L. × *P. flexilis* (eastern white × limber), and *P. ayacahuite* Ehrenb. × *P. flexilis* (Mexi-

Fig. 43. The "Mercury" pine, now designated as *P. Griffithii* $\times$ *parviflora*.

can white $\times$ limber). Limber pine normally has stomata on the dorsal surface of the needles, although in the southern part of its range the dorsal stomata may be absent (Shaw, 1914). Our hybrids involving limber pine show 1 or 2 rows of dorsal stomata while the Mercury pine has none. In addition, none of these species has cones that are typically persistent.

Thus the search for the putative parentage was narrowed to species within the group *Strobi.* Of these species, only sugar pine and Japanese white pine (*P. parviflora* Sieb. and Zucc.) have seeds as large as the unknown hybrid. The persistent cones and red immature female conelets of Mercury pine are also characteristic of Japanese white pine, and this species was considered to be one of the parents. The branches of the Mercury pine, when broken, emit an odor not unlike that of bruised tomato plants. Johnson (1952) stated that this odor is characteristic of Japanese white pine and was found in hybrids between this species and *P. Strobus* and *P. monticola* Lamb. (western white pine).

Johnson (1952) described a natural hybrid between *P. parviflora* and *P. Strobus* as $\times$ *P. Hunnewelli.* The cones on this tree were subsessile, the seeds smaller than those of Mercury pine and with long wings, and the needles between 7.5 and 8.5 cm. long. The hybrid between *P. parviflora* and *P. monticola* likewise has subsessile cones, smaller seed, and shorter needles than Mercury pine.

Thus, largely through a process of elimination, we find that *P. Griffithii* appears to be the other parent. Indeed, only this species, with its extremely long needles, long peduncle, and medium-large seed, could have contributed to some of the characteristics of Mercury pine.

Wright (1959) reported success in crossing *P. Griffithii* $\times$ *P. parviflora;* but when *P. parviflora* was used as the female parent no hybrids were obtained. Four-year-old hybrids were reported to be intermediate in growth rate and needle length. Unfortunately, none of these trees has survived.

The cones, conelets, needles, and seed of the Mercury pine and its putative parents are pictured in Figure 44. A comparison of the characteristics of the hybrid with its parents is given in Table 1. This type of presentation is known as a hybrid index as suggested by Anderson (1936) and used by Johnson (1952) in his description of $\times$ *P. Hunnewelli.* The hybrid index is an excellent method of comparison that may involve both quantitative and qualitative variables. Characters in which the two putative parents showed considerable variation were chosen for the index. Arbitrary index values (in parentheses) were then assigned, depending on the range of expression and the average, to each character. It can be seen from the sums of the index values that Mercury pine tends slightly more to *P. parviflora* in the characters listed. In tree habit and form (Figure 43), which are difficult to describe, the hybrid resembles *P. Griffithii.* When all characteristics are considered Mercury pine appears to be intermediate between the putative parents.

Discussion

The genus *Pinus* is noteworthy for the large number of natural and artificial hybrids that have been found or produced. Some of these hybrids have been formally described and given Latin names. Even at the present stage of forest

Fig. 44. The needles, closed and open cones, young conelets, and seeds of: A, *P. Griffithii;* B, the "Mercury" pine; and C, *P. parviflora.*

TABLE 1.—CHARACTERISTICS OF MERCURY PINE AND PUTATIVE PARENTS

Species	*Needle length (cm.)*	*Ventral medial resin duct*	*Female strobilus*	*Peduncle length (mm.)*	*Cone*	*Cone length (cm.)*	*Seed wing*	*Seed length (mm.)*	*Seed wing length (mm.)*	*Seed coat thickness*	*Sum of index values*
P. Griffithii	12–23 (0)	Usually present (0)	Greenish (0)	30–50 (0)	Deciduous (0)	15–25 (0)	Attached (0)	6.5–8.0 (0)	15–25 (0)	Thin (0)	— (0)
Mercury	10–16 (1)	Absent (1)	Red (2)	15–30 (1)	Persistent (2)	9–15 (1)	Attached (0)	9.0–10.5 (1)	8–14 (2)	Medium (1)	— (12)
P. parviflora	3–8 (2)	Absent (1)	Red (2)	2–5 (3)	Persistent (2)	5–10 (2)	Commonly detached (1)	11–13 (2)	5–10 (3)	Thick (2)	— (20)

genetics and tree-breeding research, new combinations involving as many as four species' genomes are being produced. If all new hybrids were given specific epithets, it would not be long before the taxonomic literature on the pines would be hopelessly cluttered. Therefore this hybrid will be known simply as the Mercury pine at the Arboretum. If this specimen later becomes widely propagated for ornamental or forestry purposes, its proper designation would be *Pinus* cl. 'Mercury' (*P. Griffithii* × *parviflora*).

It is impossible to determine the direction of this cross, that is, which species was the female and which the male parent. When this information is not known, it is customary to list the putative parents alphabetically, as in the title. The designation of Mercury as *P. Griffithii* × *P. parviflora* also conforms to Wright's (1959) data on controlled pollinations.

This specimen shows some highly desirable features which warrant its use in a pine improvement program. It has excellent straight form and exhibits heterosis or hybrid vigor in growth rate. Thus far the tree has not been attacked by the white-pine weevil, but because of the sporadic occurrence of the weevil in the Philadelphia area, it may merely have escaped this pest so far.

Three hundred seeds were extracted from cones collected in the fall of 1961. Three size classes were recognized, with approximately equal numbers in each class. Only the largest size class was used in the description of the hybrid and in the hybrid index. The medium size class was comprised of seeds 4 to 6 mm. long while the smallest class contained seeds less than 3 mm. long. None of these seeds contained viable embryos, but aborted embryos were found in all medium and large seeds. It may be that the size of the medium and large seed reflects the time at which the embryo aborted. The small seed may result from lack of pollination or fertilization.

The only white pine within effective pollination distance of Mercury is a large specimen of *P. Strobus*. Apparently the hybrid is incapable of producing many, if any, viable seed after wind-pollination by this tree. Mercury itself has not yet produced any male strobili, and the possibility of self-pollination can be ruled out. Wright (1953) noted that young *P. Griffithii* produce mainly female flowers.

Most pine hybrids produce nearly normal seed sets but may exhibit sterility of pollen ranging from 10 to 50 percent. Further studies on controlled pollination with various white pine species will be carried out to determine the crossability pattern of the Mercury pine.

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The Medicinal Garden

John Dourley[1]

III. The Essential Oils

By far the larger percentage of species in our drug collection consists of plants bearing the essential or volatile oils. The author will deal with what he considers the more important ones used in commerce; also included are several fixed oils and a number of plants containing resins and other related products used in pharmacy.

CHENOPODIACEAE. Goosefoot Family

Chenopodium ambrosioides L. var. *anthelminticum* A. Gray. The plant is a native of Central America but is found growing wild in many parts of the United States. Chenopodium oil N.F. is obtained from the seed and is used medicinally as an anthelmintic; it is a specific for hookworm.

LAURACEAE. Laurel Family

Cinnamomum Camphora (L.) Nees et Eberm. The camphor tree is a large handsome evergreen native to China, Japan and Formosa, and it is quite extensively cultivated in these countries. Although natural camphor is still used, the United States is by far the largest producers of synthetic camphor, which is produced from oil of turpentine obtained from several species of pines. The oil of natural camphor is obtained from the wood and occasionally the leaves of the camphor tree. Camphor U.S.P. is a rubefacient when used externally in preparations such as camphor and soap liniment, N.F. camphor liniment N.F. It is used internally in the form of camphor spirit N.F. or monobromated camphor N.F., when it acts as a sedative. Camphor has been used as a cardiac stimulant, but its value is limited. Other camphor preparations include camphorated opium tincture U.S.P. and flexible collodion U.S.P.

MYRTACEAE. Myrtle Family

Eucalyptus globulous Labillardière. A native of Australia and Tasmania, although it is cultivated commercially in California, south Europe and India. Eucalyptus oil is steam-distilled from the fresh leaves of this and other species. Medicinally, eucalyptus oil N.F. is used as an expectorant in the treatment of bronchitis, and is an antiseptic in inhalents and nose and throat sprays.

Melaleuca leucadendron L. Often referred to as the Cajaput or White Tea tree, it is a native of the East Indies. Cajaput oil is distilled from the fresh twigs and leaves and is used medicinally as a stimulant, antispasmodic and diaphoretic. It is also used in lotions for rheumatic afflictions, toothaches, neuralgia, sprains and bruises. Ol. cajuput B.P.C.

LABIATAE. Mint Family

Lavandula officinalis Chaix. (*Lavandula vera* DC.) This species is native to the Mediterranean countries and is cultivated in many gardens. Commercial supplies come principally from southern Europe. Lavender is possibly in greater demand by the perfume industry than in medicine, although in the past it was used as a stimulant and carminative. Lavender oil U.S.P. is used in the preparation of lavender water, it is also an ingredient of aromatic ammonia spirit U.S.P. and medicinal soft soap liniment U.S.P. Spike lavender oil is distilled from *Lavandula latifolia* Vill. and other species growing in France and Spain and is used largely in preventing insect bites.

Rosmarinus officinalis L. Rosemary is indigenous to southern Europe, but is commercially grown in France, Spain and North Africa. The oil is distilled from the fresh flowering tops of the plant. Rosemary oil N.F. is used as an aromatic flavor, carminative and rubefacient. It was once a popular hair wash and an infusion of rosemary combined with borax is said to prevent premature baldness.

Mentha piperita L. Peppermint is indigenous to Europe although it has become naturalized in the northern United States and Canada. The plant is quiet extensively cultivated in the states of Oregon, Indiana and Washington. Peppermint oil U.S.P. is the volatile oil distilled from the herb and is used in the preparation of peppermint spirit U.S.P. which is employed as a carminative and flavoring agent. Menthol U.S.P. is an alcohol obtained from peppermint oil or other mint oils; it is reported that the Japanese mint, *Mentha arvensis* var. *piperascens* Malin., has a very high menthol content. The drug (menthol) is also produced synthetically; it is used as a cooling analgesic and anodyne.

Thymus vulgaris L. Southern Europe. Thyme is grown commercially in Italy, Spain, France and Greece. Thyme oil is a volatile oil distilled from the flowering plant. Thyme oil N.F. thyme fluid extract and thyme syrup are used for their carminative and anti-spasmodic action. Thymol

[1] This is the last in a series of three articles dealing with the plants in the Arboretum's Medicinal Garden.

N.F. is produced from thyme oil N.F. or prepared synthetically; it is a powerful germicide and is used as an anti-bacterial mouthwash; it is also a very effective anthelmintic.

VALERIANACEAE. Valerian Family

Valeriana officinalis L. Valerian is indigenous to Europe and northern Asia, and is grown commercially in England, France, Belgium, Holland and Germany. The drug consists of the dried rhizome and roots of the plant. It is interesting to note that cultivated plants grown in England are usually octoploid, while those cultivated in Europe are tetraploid. The drug was used in ancient medicine; it was known to the Greek physician Dioscorides under the name of Phu, and was referred to by Leonhard Fuchs in 1542 as Phu Germanicum. Valerian appears to have been used quite extensively immediately after World War I in the treatment of shell shock. It is used as a nervine and anodyne and can be given in all causes of nervous debility and irritation; also in hysterical afflictions. Strongly nervine, without any narcotic effects, it enters into various herbal nervine and anti-spasmodic compounds and has gained added importance with its properties and actions in neurosis and epilepsy. Ammoniated tincture of Valerian B.P.C.

COMPOSITAE. Composite Family

Arnica montana L. is a native of central Europe. Arnica N.F. consists of the dried rhizome and flowers of the plant and is used medicinally as a stimulant and vulnerary, although its principal use is as a counter-irritant, e.g., a local application for bruises and swelling, Arnica tincture N.F. Since the drug is an active irritant, care must be exercised in internal employment, as cases of severe poisoning have been recorded.

Grindelia robusta Nutt. This plant is found growing wild in North America and it has been largely employed in the treatment of asthmatic and bronchial afflictions. The drug is said to reduce the violence and frequency of the paroxysm in asthma and is also used as a diuretic and tonic. Ext. Grindel Liq. B.P.C. 1949.

Saussurea Lappa Clark. The Costus, as it is sometimes known, is indigenous to India, and is found growing on the northwestern portion of the Himalayas especially on the moist slopes of the mountains around the valley of Kashmir. The oil is derived from the roots of the plant and has been used in Ayurvedic and Tibbi medicine from early times. A great deal of the roots was shipped to China in large quantities, for use as incense, as a spice and medicinally. The merchants of Kashmir found employment for the plant to protect their fabrics from moths and other vermin. It is reported that the oil has a strong, aromatic, penetrating and fragrant odor, and it has antispetic properties. It is also considered a cardiac stimulant, carminative, expectorant and diuretic.

Anthemis nobilis L. Europe. The Roman Chamomile has been cultivated in English gardens for many centuries, but the main source of commercial supplies is probably from France, Belgium and Hungary. The plant has been used in domestic medicine since early times, the herb and flowers being equally valuable medicinally as a stomachic, anti-spasmodic, tonic and emmenagogue. Ol Anthem B.P.C., 1949 (Oil distilled from the flowers.)

Artemisia Cina (Berg) Willkomm. Wormseed grows abundantly in the northeastern districts of the province of Turkestan, but appears to be cultivated commercially to some extent in Spain. The drug consists of the unexpanded flower heads of this, and possibly other species, and contains a volatile oil and other principles including santonin, which is used medicinally as an anthelmintic for round worms, which it rapidly expels. The drug is official in the forms of santonin tablets N.F. and santonin mild mercurous tablets N.F.

IV. The Fixed Oils

LINACEAE. Flax Family

Linum usitatissimum L. Europe. Flax or Linseed. Apart from being cultivated for its fibers in the manufacture of textiles, flax is also grown for the fixed oil expressed from the seeds. Linseed oil N.F. is used medicinally as a pectoral, demulcent and emollient. The oil is used largely as an addition to cough medicines, and externally as an application for burns, scalds, etc. The crushed seeds make a valuable poultice in bronchitis.

MALVACEAE. Mallow Family

Gossypium herbaceum L. Cotton Plant. This species is a native of the East Indies, but has been grown in India from very early times. Its cultivation spread to China and Egypt where cotton was cultivated as long ago as 500 B.C. The Phoenicians were no doubt responsible for its introduction to the Mediterranean area. It is interesting to note that cotton cloth was first brought to Britain from Calicut in India, hence the name calico given to cotton fabrics. *G. herbaceum* was brought to the United States in 1774; today this country is possibly the largest of the world's cotton producers, followed by Brazil, Egypt and India.

Cotton is used in medicinal practice in the form of absorbent cotton which is made from cotton waste. Oxidized cellulose is prepared by the oxidation of cotton by means of nitrogen dioxide, this product appears to be used as a

haemostatic, chiefly in brain surgery. Cotton seed oil U.S.P. is the refined fixed oil obtained from the seed of cultivated plants of several species of *Gossypium;* it is used as emollient and often administered as a mild carthartic. In a refined form the oil is used as a solvent for certain hormone injections. The root bark is medicinally employed as an emmenagogue, parturient and oxytoxic. The drug is said to contract the uterus in a more effective and safe manner than ergot.

OLEACEAE. Olive Family

Olea europaea L. The Olive is a native of the Mediterranean regions. It is a small evergreen tree from the fruit of which is expressed the oil or olive oil U.S.P.

The purest oil is often referred to as virgin or Provence oil and has a faint greenish color. It is used medicinally as an emollient, nutritive and aperient. It is often substituted for castor oil as a children's laxative and in the treatment of lead colic, whereas the common olive oil is often adulterated with purified cottonseed oil and is used in the manufacture of soaps, etc.

FLACOURTIACEAE. Flacourtia Family

Hydnocarpus Wightiana Blume. The tree is indigenous to India and Burma and the fixed oil (referred to as Chaulmoogra Oil) is expressed from the ripe seed has been used in the treatment of leprosy for many centuries; it was still the most effective remedy until comparatively recent times. The drug is also considered a sedative and febrifuge and as a dermatic in the treatment of psoriasis and eczema. The drug can be administered orally or by subcutaneous and intramuscular injection. Recently a synthetic drug appeared on the market called Promin which has to some extent replaced Chaulmoogra or Hydnocarpus oil B.P. in the treatment of leprosy.

V. Resins and Oleoresins

POLYPODIACEAE. Polypody Family

Dryopteris Felix-mas (L.) Schott. The Male Fern is indigenous to the British Isles and Europe, while the related *D. marginalis* (L.) Gray is found in the eastern and central United States. These two species are known in commerce as European and American Aspidium respectively and are official in most pharmacopoeias. The drug (oleoresin) is obtained from the pounded rhizome and the frond bases of the fern. European Aspidium comes principally from Germany and Holland in the form of oleoresin while the American material comes from New Hampshire. The vermifuge properties of the fern were mentioned in the works of Dioscorides, Theophrastus, Galen and Pliny. In medicine it is still considered one of the best taeniacidal drugs available, and no doubt one of the oldest. It is one of the few drugs which are a specific for tapeworm, but great care must be taken in administering as it is an irritant poison.

ZINGIBERACEAE. Ginger Family

Zingiber officinale Roscoe. The plant is native of southeastern Asia, but is cultivated in many tropical countries, notably the West Indies, Nigeria and West Africa. Ginger consists of the dried rhizome of the plant. The most highly valued ginger comes from Jamaica; it is used largely as a condiment, and medicinally as a carminative, aromatic and stimulant to the gastrointestinal tract. Ginger N.F. and ginger oleoresin N.F.

CANNABINACEAE. Hemp Family

Cannabis sativa L. The hemp plant was originally native of western and central Asia, but now has a vast distribution. The drug is obtained from the flowering or fruiting tops of the pistillate plants, the principal constituent being cannabinol which has a powerful narcotic action. It was made official in the British and United States Pharmacopoeias in the early part of the last century and was used medicinally as an hypnotic anodyne and anti-spasmodic.

The use of hemp for euphoric purposes is widely spread in Asia and Africa, where the drug is habitually indulged by millions. There is little doubt that the use of Cannabis to induce intoxication is of Asian origin; such preparations as Bhang, Ganja and Charas have been highly esteemed since time immemorial by Asiatic people, while Hashish is equally so esteemed by many Egyptians and Algerians. One recalls the United States efforts to control the hemp drug here in the form of cigarettes or reefers containing marihuana.

BERBERIDACEAE. Barberry Family

Podophyllum peltatum L. The May Apple is a low-growing woodland plant, indigenous to eastern United States and Canada. Podophyllum consists of the dried rhizome of the above species, the active constituent being the resin or podophyllin. The drug is used medicinally as a purgative, cathartic and cholagogue. A paint of podophyllin is used in the treatment of warts: Tinct. podoph B.P.C. 1949.

SOLANACEAE. Nightshade Family

Capsicum frutescens L. Africa. Sometimes referred to as African Chilles. Capsicum oleoresin N.F. and Capsicum N.F. (Cayenne Pepper) are obtained from the dried ripe fruit of this and other species. Medicinally, capsicum oleoresin is a powerful rubefacient and is usually administered as a plaster or ointment, while Capsicum tincture N. F. is used as a carminative and stomachic. The drug is considered the purest and most certain stimulant in herbal materia medica.

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Morris Arboretum Bulletin

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Libocedrus decurrens at Tervuren

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

On November 8 the Director spoke to the Merion Garden Club on the "Pine Barrens of New Jersey" and on December 4 he gave an illustrated lecture entitled "Scandinavia and the Low Countries" at the Faculty Club of the University of Pennsylvania.

The Director has recently accepted an appointment as a member of a newly formed Advisory Committee to the National Parks Service which has been established under the auspices of the National Academy of Sciences.

Dr. Li has received a grant from the National Science Foundation for the publication of his studies on the Trees and Shrubs of Formosa. This work will appear as a Morris Arboretum Monograph.

On October 5 Dr. Allison participated in a panel discussion of Rachel Carson's controversial book "Silent Spring." This took place over WCAU on Gordon Scott's popular program "Night Watch".

Recently Dr. Allison has been appointed to Pompeston Creek Natural Park Area Committee of Cinnaminson Township, New Jersey.

(*Continued on Page 68*)

The Sixteenth International Horticultural Congress

John M. Fogg, Jr.

Between August 31 and September 8, 1962, nearly a thousand individuals from 52 different countries attended the XVIth International Horticultural Congress, which was held at Brussels.

With this as an excuse — as if one needed an excuse to go to Europe — my wife and I left Philadelphia on August 10 for Norway, where we spent a glorious week among the fjords, then traveled through Sweden, Denmark and Holland arriving in Belgium in time for the formal opening of the Congress.

Fig. 46. View from the Mont des Arts, Brussels.

The headquarters of the Congress were located in the fine new buildings of the Palais des Congrès (Fig. 45) on the Mont des Arts overlooking the city (Fig. 46) and only a few blocks from the world-famous Grand' Place. This section, with its handsome new library edifice and projected Art Galleries, is rapidly becoming the intellectual and cultural center of the Belgian capital.

The sessions of the Congress were divided into general lectures and sectional conferences. The former were held in the magnificent auditorium of the Palais, where, through the medium of individual ear-phones, members of the audience could listen to the speaker in English, French or German, the official languages of the Congress.

Of special interest to the nearly one hundred American representatives in attendance was the superb lecture given at the opening session by Professor H. B. Tukey, of Michigan State University. Dr. Tukey's subject was "The Role of Horticulture in Science and Society." The other general lecturers, heard throughout the week, were Drs. F. Pansiot of Italy, W. Busch of West Germany, and J. Bustarret of France.

Fig. 45. The Palais des Congrès, Brussels.

The sectional conferences were divided into five main categories: Vegetable Culture, Fruit Culture, Floriculture, Arboriculture and Tropical and Subtropical Horticultural Crops. Each of these was further divided into subsectional meetings devoted to such considerations as Plant Breeding and Propagation, Soils and Fertilizers, Plant Diseases, Environment and Technology.

In addition to the formal sessions there were several colloquia and symposia. The International Association of Botanical Gardens sponsored a two-session colloquium devoted to, "The Modern Role of the Botanical Garden." This conference was under the chairmanship of Dr. Richard A. Howard, Director of the Arnold Arboretum, and the discussants included Dr. J. Sealy of the Royal Botanic Gardens at Kew, Dr. John Gilmour, Director of the Cambridge Botanical Garden, Dr. R. T. M. Pescott of the Royal Botanic Gardens, Melbourne, Australia and Dr. Russell J. Seibert, Director of the Longwood Gardens, Kennett Square, Penna.

Dr. Seibert also presided over a significant colloquium concerned with the participation of amateurs in horticulture. One outcome of this conference was the firm recommendation that Horticulture for Amateurs be accorded a permanent place within the structure of The International Society for Horticultural Science.

Tremendous credit is due the officers of the Congress not only for the organization of the

Fig. 47. A section of the Deconinck — Dervaes Nursery.

formal program and the well ordered physical arrangements, but also for providing a fine series of field-trips. Several of these were all-day general excursions to places of historical or scientific interest; others were shorter trips within the city or its environs.

The first general excursion which occurred on Sunday, September 2, took us (fifteen busloads strong) first to Bruges where after a tour of several monuments and museums, luncheon was served in the 15th century Gothic town hall.

In the afternoon we visited the famous Deconinck-Dervaes Nurseries at Maldegem (Fig. 47). Here are many acres of roses and a fine array of conifers, deciduous trees and shrubs as well as herbaceous plants. Returning home through Lochristi, we caught glimpses of hundreds of acres of tuberous begonias which are to Belgium what tulips are to Holland. Indeed, the symbol of the Congress was the begonia.

The second general excursion on the following Sunday, went southward through the grape-raising country of Namur and the Meuse Valley to Annevoie, where the members of the party wandered for some time among the canals and grottoes of an 18th century garden with its 15th century castle. This outing was climaxed by a visit to the renowned caves at Han-sur-Lesse.

Although not listed as a "general excursion", the all-day visit to the agronomic and horticultural research centers near Ghent was an impressive experience. It began with a brief stop at the gigantic flower auction installation at Aal, followed by an inspection of the extensive greenhouse constructions at Vercauteren, the State Experiment Station and the State Horticultural School at Melle. Here we were shown experimental work in progress with begonias, gloxinias and a number of other groups of plants. The expedition then moved on to the State Agricultural University and Research Center at Ghent. Here, after a luncheon, at which we were the guests of the Congress, an opportunity was provided for inspecting the laboratories and research activities of the institution. On the way back to Brussels, the party stopped for refreshments at Laarne which boasts a 12th century castle, replete with moat and drawbridge.

Of the shorter trips, two in particular were memorable. One of these was to the Arboretum of Kalmthout, which was founded in 1856 by the Antwerp Nurseryman, Charles van Geert. Today it is presided over by Mr. and Mrs. Robert de Belder, a charming couple who took great delight in showing us their botanical treasurers. Here are over 4000 species and varieties of woody plants, some of them of great rarity, all of them well grown and beautifully displayed. Selection work in *Rhododendron, Hamamelis, Acer* and many other genera is now in progress. The warm hospitality of our hosts will not soon be forgotten by those who had the good fortune to participate in this visit.

Also highly exciting was an afternoon spent in the Geographic Arboretum of Tervuren, established in 1902 and situated in the forest of Soignes, a few miles outside of Brussels. Here, in an area of only 260 acres, are grouped the important forest associations of the temperate areas of the world, primarily the northern hemisphere. These are arranged in mixed stands which effectively simulate natural forest communities. Approximately 160 acres are allotted to the trees of the New World, the remainder to those of the temperate regions of Europe, Asia and Africa.

Our host here was Dr. U. G. Liénard, the Director of the Arboretum. Dr. Liénard conducted us first through several acres devoted to the forest trees of Alaska. Here are fine plantings of Sitka Spruce (*Picea sitchensis,* Fig. 48), Western Hemlock (*Tsuga heterophylla*) and Alaska Cedar (*Chamaecyparis nootkatensis*). It was amazing to see thousands of hemlock seedlings on the forest floor, as though this were a formation which had become established over the centuries instead of a mere 60 years or less.

Fig. 48. *Picea sitchensis* at Tervuren.

Fig. 49. *Abies amabilis* at Tervuren.

The next area was British Columbia and here, in addition to the Alaskan conifers, are magnificent specimens of Douglas Fir (*Pseudotsuga taxifolia*) and Western Red Cedar (*Thuja plicata*) along with such deciduous species as *Acer macrophyllum*, *A. circinatum*, and *Populus trichocarpa*.

The section devoted to the Cascades in the vicinity of Mount Rainier, contains most of the preceding, but also White Fir (*Abies amabilis*, Fig. 49) Lowland White Fir (*A. grandis*) and Noble Fir (*Abies nobilis*). Here also are Engelmann Spruce (*Picea Engelmanni*) and Lodgepole Pine (*Pinus contorta*).

The forests of Western Oregon include such specialties as the California Nutmeg (*Torreya californica*) the Redwood (*Sequoia sempervirens*) and the Port Orford Cedar (*Chamaecyparis Lawsoniana*), while the Sierra Nevadas of California have a rich forest flora consisting of most of the above plus four species of pines (*P. ponderosa*, *P. Lambertiana*, *P. Jeffreyi* and *P. Murrayana*), the Big Tree (*Sequoiadendron giganteum*, Fig. 50) Silver Fir (*Abies concolor*) and the Incense Cedar (*Libocedrus decurrens*, See Cover.) Other western forest areas represented are Idaho, Montana and Colorado.

The only planting devoted to the southern hemisphere is an impressive grove of Monkey Puzzle Trees (*Araucaria araucana*) which are native to Chile.

Considerable acreage is devoted to the forests of eastern North America, extending from New Brunswick and Ontario south through New England and Pennsylvania to North Carolina, Tennessee and Alabama. In the area allotted to Pennsylvania alone there are over 40 species of trees. Nine of them are conifers including Canada Fir (*Abies balsamea*), Hemlock (*Tsuga canadensis*), three spruces, two pines and the Arbor-vitae (*Thuja occidentalis*). The rest are the dominant broad-leaves species characteristic of the Appalachian deciduous forest, such as poplars, hickories, walnuts, birches, oaks, elms, maples, lindens and ashes. Here, again, one is impressed with the maturity of the stands and the fact that these species are thriving in a part of the world which suffered such a severe decimation of its own forest flora in Pleistocene times.

In the hundred or so acres devoted to the forests of the Old World there are twenty different groups. These range from Scandinavia south through Spain to Algeria and eastward across Central Europe and the Mediterranean Basin to Asia Minor, the Caucasus, Iran, Nepal, Manchuria, China and the Japanese Archipelago.

Those of us who are interested in trees which are hardy in temperate eastern North America were especially intrigued by the sections of the Arboretum allocated to such areas as Jugoslavia, the Balkans and the Caucasus. Collectively these regions have contributed to our arboretums many pines, e.g. *Pinus Peuce*, *P. Pinaster*, *P. leucodermis*; several fine firs, e.g. *Abies cephalonica*, *A. pectinata*, *A. cilicica*, *A. Nordman-*

Fig. 50. *Sequoiadendron giganteum* at Tervuren.

Fig. 51. The Castle at the Jardin Botanique de Meise.

niana; the stately Serbian Spruce (*Picea Omorika*) as well as the monumental Oriental Spruce (*P. orientalis*) and a host of useful and handsome hardwoods.

Altogether, I think it is correct to state that Tervuren is an arboretum in the truest meaning of the word, imaginatively conceived, intelligently planted and beautifully maintained.

Finally, mention should be made of the Jardin Botanique de Meise, the newly established state botanical garden a few miles outside the city of Brussels. Here the Director, Dr. W. Robyns, offered hospitality to the members of the Congress and kept open house while the sessions were in progress. This garden is in the middle of a beautiful estate near the center of which is the castle where the Empress Carlotta of Mexico spent the last years of her long life (Fig. 51). Large conservatories and growing houses are nearing completion and this institution bids fair to take an honored place among the distinguished botanical gardens of Europe.

The XVIIth International Horticultural Congress will be held in the United States in 1966. American botanists and horticulturists will find it difficult to achieve the high standards of excellence recently set by their colleagues in Belgium.

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since September, 1962:

Mrs. G. Stark Compton

Mrs. Charles Dulles

Mr. Edward B. Figorski

Mr. Louis P. Harrington

Mrs. Pierre D. Houdry

Mr. W. T. Jones

Mr. Philip B. Knowlton

Miss Jean MacFarland

Mr. William F. O'Shaughnessy

Mrs. David Primm

Mrs. George V. Robertson, Jr.

Miss Ruth Robinhold

Dr. William C. Steere

Mrs. Thomas W. Williams

The Cultivated Corylopsis

Hui-Lin Li

The genus *Corylopsis* includes some highly ornamental shrubs with handsome foliage as well as showy blossoms. The light or greenish yellow flowers which are generally fragrant appear on slender nodding clusters in early spring before the leaves. In the Philadelphia area, these plants usually flower in early April, before most other shrubs are in bloom. They bloom at about the same time as the more widely planted Forsythias, but their smaller and paler flowers, clustered in pendant racemes like tassels hanging on bare branches, present a more elegant and pleasing sight than the coarser Forsythias with their stout, stiff branches densely covered with deep yellow and overly showy flowers.

Corylopsis, as yet little cultivated outside of botanical gardens, is thus especially recommended to the more sophisticated home gardeners who want to have something different from the rather ubiquitous Forsythias to usher spring into their gardens. Besides possessing the virtue of early flowering, *Corylopsis* is also decorative in its foliage. The leaves are generally ovate in shape, of moderate size and of a pleasing shade of light green, tinged with red in some species. They appear, with bristle-teeth along the margins, like leaves of Hazel (*Corylus*), hence the name *Corylopsis.* The several growth forms of the different species offer a selection of types for various uses in the garden.

Fig. 52. *C. platypetala.*

Fig. 53. *C. platypetala* espaliered on wall at Princeton University.

Corylopsis is an Asiatic genus of the Witch-Hazel family (Hamamelidaceae). There are about 20 known species. The census of Tong (1930) in 1930 lists 13 species in the genus but since then a number of new ones have been proposed, especially from southwestern China. The genus occurs in eastern Asia from Japan, Korea and China to the eastern Himalaya. About ten of the species are in cultivation, while the remaining ones are either little known or recently described species. Of the ten species in cultivation, *C. yunnanensis* Diels and *C. Griffithii* Hemsley, from Yunnan, China and eastern Himalaya respectively, are not hardy in our area. The other eight species are all represented in the living collection of the Morris Arboretum. Although these species are all perfectly hardy, the flowers may sometimes be damaged by frost in early spring because of their early flowering habit.

All species of *Corylopsis* are deciduous shrubs; most of them branch densely from the root and develop into either wide-spreading plants or more or less pyramidal ones. The branchlets are generally slender and marked with numerous lenticels. The leaves are mostly ovate in outline and with long bristly sometimes reflexed teeth along the margins. They are strongly veined, with the lateral veins ending in the marginal teeth. The shape of the leaves and the presence or absence of pubescence on the young branch-

Fig. 54. *C. spicata.*

lets, petioles and leaf-surfaces are important characters for species diagnosis.

The flowers are short-stalked or nearly sessile, and vary from two to three to over twenty in each inflorescence, racemosely arranged on an elongated axis. (Figs. 52, 55, 56, 59). There are several large membranaceous empty bracts at the base of the raceme and slightly smaller ones above, each bearing one flower in the inner axil. These bracts have long silky hairs on one or both surfaces. The calyx, enclosing the half-inferior ovary, is either pubescent or glabrous and has five short lobes. There are five narrow or broad petals which are constricted and clawed at the base. The five stamens alternate with five short, either entire or bifid or sometimes irregularly 2-3-parted staminodes which function as nectaries. The two styles are distinct and are either as long as the stamens or longer and are either included in the flower or exserted. The fruit, a broad ovoid 2-valved woody capsule, flat at the end and with four spreading recurved ends, somewhat resembles the fruit of the Witch-Hazel. Each capsule contains two or four shining black oblong seeds.

The cultivation of *Corylopsis* is similar to that of the more familiar Witch-Hazel (*Hamamelis*). In their natural habitat, the species are mostly woodland plants growing in thickets and along the edges of forests. In cultivation they can be grown in any habitat, but thrive best in peaty or sandy soil. They can be propagated by seeds, cuttings or layering. Cuttings are made from well ripened shoots taken during the summer and struck in heat (Creasy 1934).

Since the plants flower well in advance of the leaves, by the time the leaves are fully developed, the flowers have already faded. For this reason, two keys for the identification of the eight commonly cultivated species are here presented: one based on vegetative and the other on floral characters. These keys are followed by brief descriptions of the various species.

Key based on Vegetative Characters

A. Young branchlets pubescent
- B. Pubescence on young branchlets stellate; leaves when mature glabrous or sparingly pubescent beneath more or less on the veins only .... 8. *C. Wilsonii*
- B. Pubescence on young branchlets not stellate; leaves more or less densely pubescent beneath.
  - C. Leaves obovate, broadest above the middle; pubescence on branchlets mixed with stipitate glands ..4. *C. sinensis*
  - C. Leaves orbicular-ovate, broadest below the middle; pubescence on young branchlets without stipitate glands. 5. *C. spicata*

A. Young branchlets glabrous or nearly so
- B. Leaves with 5-7 pairs of lateral veins
  - C. Leaves green when young, the mature ones 3-7 cm. long, sparingly pubescent along the veins beneath 2. *C. pauciflora*
  - C. Leaves purplish beneath when young, the mature leaves 5-12 cm. long, completely glabrous beneath 6. *C. Veitchiana*
- B. Leaves with 6-11 pairs of lateral veins
  - C. Young branchlets and petioles very sparingly stipitate-glandular; leaves up to 10 cm. long ......3. *C. platypetala*
  - C. Young branchlets and petioles more or less completely glabrous, not stipitate-glandular.
    - D. Leaves ovate, acuminate, the base cordate to subcordate; petioles slender, 1.5-3. cm. long 1. *C. glabrescens*
    - D. Leaves mostly obovate, sometimes ovate, short-acuminate, the base truncate to subcordate; petioles 0.5-2 cm. long ...7. *C. Willmottiae*

Key based on Floral Characters

A. Calyx glabrous; fruit glabrous
- B. Flowers 2-3 to a raceme ..2. *C. pauciflora*
- B. Flowers 6 or more to a raceme
  - C. Basal and floral bracts of racemes silky pubescent on both surfaces; staminodes truncate or slightly emarginate 8. *C. Wilsonii*
  - C. Basal bracts of racemes glabrous outside, pubescent inside; staminodes bifid
    - D. Petals suborbicular, about 3-4 mm. across; racemes 3.5-7 cm. long
      - E. Racemes 5-7 cm. long 7. *C. Wilmottiae*

E. Racemes 3.5-5 cm. long
3. *C. platypetala*

D. Petals longer and narrower, obovate, about 8 mm. long; racemes 2-3.5 cm. long . . . . 1. *C. glabrescens*

A. Calyx pubescent; fruit pubescent

B. Floral bracts of racemes glabrous outside, pubescent inside; racemes 7-10-flowered

C. Racemes 3-5 cm. long; anthers yellow, included . . . . 4. *C. sinensis*

C. Racemes 2.5-5 cm. long; anthers reddish-brown, slightly exserted
6. *C. Veitchiana*

1. *C. glabrescens* Franch. & Sav.
(*C. Gotoana* Makino)

Shrubs 1-2 m. high; young branchlets very slender, glabrous. Leaves ovate, acuminate, obliquely cordate, 3-8 cm. long, glaucescent beneath and sparingly hairy on the veins; lateral veins about 7-11 pairs; petioles 1.5-3 cm. long. Racemes 8-12-flowered, ca. 3.5 cm. long; rachis glabrous; bracts silky hairy inside, glabrous outside; calyx glabrous; petals obovate, 8 mm. long, about as long as the stamens and styles; staminodes deeply bifid. Fruit glabrous.

This species is native to the mountain regions of central Japan. It was first introduced into North America in 1905 by Prof. J. G. Jack. Rehder (1940) describes this as the hardiest species in the genus but Bean (1950) notes that most of the Japanese and Chinese species are quite hardy in the British Isles except that the flowers are liable to injury by late spring frost. Although the plant blooms freely, it has rather small flowers and it is not as ornamental as some of the other species.

2. *C. pauciflora* Sieb. & Zucc.

A low, much branched spreading shrub 2-3 m. high; young branchlets glabrous, very slender. Leaves ovate, obliquely cordate, 3-5 cm. long, sparingly pubescent on the veins and glaucous beneath; lateral veins of 5-9 pairs; petioles 5-15 mm. long, glabrous. Racemes short, 2-3-flowered, 1-1.5 cm. long; rachis glabrous; bracts glabrous outside; calyx glabrous; petals obovate, 7-8 mm. long, slightly longer than the stamens; anthers brownish-yellow; staminodes entire. Fruit glabrous.

This species is native to the mountains of Japan and is also cultivated in the gardens there. According to Rehder (1940), it was introduced into America in 1862. This probably refers to the introduction of this plant by Dr. George R. Hall, who first brought a specimen of this species from Japan to Bristol, Rhode Island in the year 1874 (Anonymous 1892). According to Bretschneider (1898), Robert Fortune introduced this species, together with *C. spicata*, from Japan into England in 1860-61. Bretschneider also states that Maximowicz sent seeds from Japan to the Botanical Garden at St. Petersburg in 1862.

Among all members of the genus, this one has the shortest racemes with the smallest number of flowers. However, the racemes are freely produced and the individual flowers are relatively large and more open, so that the species compares favorably with the others as an ornamental.

3. *C. platypetala* Rehder & Wilson

Spreading shrub to 3.5 m. high; young branchlets glabrous but with scattered stipitate glands. Leaves ovate to elliptic, short-acuminate, cordate, 5-10 cm. long, glabrous beneath; lateral veins of 6-10 pairs; petioles 1-2.5 cm. long, sparingly stipitate-glandular. Racemes many-flowered, 3.5-5 cm. long; rachis glabrous; calyx glabrous; petals suborbicular, 3-4 mm. long, longer than the stamens and styles; staminodes emarginate to bifid. Fruit glabrous. (Figs. 52 and 53)

This species was discovered in western China and introduced into cultivation by E. H. Wilson

Fig. 55. Inflorescence of *C. spicata*.

Fig. 56. Flowers of *C. spicata.*

in 1907. He found it a common shrub in western Hupeh growing in thickets and along margins of woods, at an altitude of 1600 to 3000 m. (Rehder & Wilson 1913).

The plant is characterized by the very broad hatchet-shaped petals. The young branchlets and petioles are glabrous but with scattered stipitate glands. There is a variety *laevis* Rehder & Wilson, also from western China, which differs in being completely glabrous and lacking glands on the young branchlets and petioles.

Among the hardier species, this is one of the more showy. Because of the broad petals the long hanging racemes, with many flowers, are fuller in appearance than most others. A most ornamental specimen of this species is found in the yard of the Graduate Compound at Princeton University where it is espaliered on the wall of a building. (Fig. 53)

4. *C. sinensis* Hemsley

Shrub 2-5 m. high; young branchlets pubescent and stipitate-glandular. Leaves obovate, short-acuminate, obliquely cordate, 5-12 cm. long, glaucescent beneath and pubescent especially on the veins; lateral veins about 7 pairs; petioles pubescent, about 5-15 mm. long; rachis pubescent; bracts orbicular, hairy on both surfaces; calyx pubescent; petals orbicular-ovate, 7-8 mm. long, slightly longer than the stamens and the styles. Fruit pubescent.

This is the common Chinese species found abundantly in the Lushan area in central China and also in western China, in western Hupeh and eastern Szechuan. It grows in thickets and woodlands at an altitude of 1300-2000 m. (Rehder & Wilson 1913). Wilson introduced this species into England for the Veitch firm in 1900.

This species was originally believed to be the same as the Japanese *C. spicata.* Hemsley subsequently established it as a distinct species in 1906 (Hemsley 1906). From *C. spicata* it can be differentiated by its relatively narrower leaves, more-flowered racemes and its villous instead of glabrous bracts.

5. *C. spicata* Sieb. & Zucc.

Shrubs 2-3 m. high; young branchlets pubescent. Leaves ovate to obovate, short-acuminate, obliquely rounded to cordate, 4-10 cm. long, glaucous and pubescent beneath; lateral veins of about 8 pairs; petioles densely pubescent, 1-2.5 cm. long; rachis pubescent; bracts ovate, silky inside, glaucous outside; calyx pubescent; petals obovate, 7 mm. long; stamens slightly longer than the petals, the anthers brownish-yellow; staminodes bifid. Fruit pubescent. (Figs. 55 and 56)

This species is native to the mountains of Japan and it is frequently planted in the gardens there and known by the name "Avomomi" (Anonymous 1874). It was introduced, together with *C. pauciflora,* by Robert Fortune into England in 1860-61 (Bretschneider 1898). Veitch also introduced the plant into England from Yokohama, Japan in 1863 and his plants first flowered in 1865, a year after the plants introduced by Fortune flowered in England (Hooker 1864, Lindley 1865).

The plant is a wide-spread shrub, many stemmed from the base and with crooked flexible branches. Two large plants at the Morris Arboretum, planted about fifty years ago each now measure about eight feet tall and twelve feet broad.

Fig. 57. *C. spicata* × *pauciflora.*

Fig. 58. *C. Veitchiana*

There is a hybrid between *C. spicata* × *C. pauciflora* which shows intermediate characters between the two. A plant in the Morris Arboretum collection was raised from cuttings from Winterthur. (Fig. 57)

6. *C. Veitchiana* Bean

Shrub 1-2 m. high; young branchlets glabrous. Leaves elliptic, short-acuminate, subcordate, 7-12 cm. long, purplish and sparingly silky beneath when young, soon glaucous and glabrous; lateral veins of 6-7 pairs; petioles glabrous, 6-15 mm. long. Racemes many-flowered, 2.5-5 cm. long; rachis pubescent; basal bracts glabrous outside; floral bracts silky outside; calyx pubescent; petals obovate, slightly shorter than the stamens; anthers reddish brown; staminodes bifid. Fruit pubescent. (Fig. 58 and 59)

This species grows commonly in western Hupeh, China, in thickets and along margins of woods, at an altitude of 1300-2000 m. (Rehder & Wilson 1913). Rehder (1940) gives 1900 as the date of introduction but Beckett (1912) states that it was first introduced by E. H. Wilson for the Arnold Arboretum in 1908.

The plant has an upright habit and with rather straight branchlets. It is highly floriferous and very ornamental, the beauty of the flowers being enhanced by the reddish anthers. The young leaves and bracts have a showy purplish tinge which is quite distinctive.

7. *C. Willmottiae* Rehder & Wilson

Shrub to 4 m. high; branchlets glabrous. Leaves ovate to obovate, short-acuminate, cordate to truncate, 3-8 cm. long, glaucescent beneath and pubescent on the veins; lateral veins of 7-11 pairs; petioles 5-20 mm. long, glabrous or slightly pubescent. Racemes many-flowered, 5-7 cm. long; rachis pubescent; calyx glabrous; petals suborbicular, 3-4 mm. long, longer than the stamens and styles; staminodes bifid. Fruit glabrous.

This species was discovered and introduced into cultivation by E. H. Wilson in 1908 from western China in Sikang province. He found it growing quite commonly in thickets along margins of woods throughout the area at altitudes of 2000 to 2600 m. (Rehder & Wilson 1913).

This is a floriferous plant with rather long flower racemes. Among the distinctive characters are the glabrous branchlets, calyx and ovary, while the leaves are hairy beneath mostly on the veins.

8. *C. Wilsonii* Hemsley

Shrub, sometimes a small tree; young branchlets stellate-pubescent. Leaves ovate to elliptic, acuminate, cordate, 6-12 cm. long, glaucous and pubescent especially on the veins beneath; lateral veins of 6-9 pairs; petioles densely pubescent, 1-2.5 cm. long. Racemes 8-12-flowered, 5-7 cm. long; basal bracts as well as floral bracts silky pubescent on both surfaces; calyx glabrous; petals oblong, 6 mm. long, slightly longer than the stamens; staminodes truncate. Fruit glabrous.

Fig. 59. Flowers of *C. Veitchiana*

This species was discovered in China by E. H. Wilson in 1900 and introduced into England (Bean 1950). It occurs in Hupeh and Kweichow provinces in central to southwestern China at an altitude of 500-1200 m.

The plant somewhat resembles *C. Veitchiana* but it can be readily distinguished by its glabrous calyx and fruit. A character that differentiates it from all other cultivated species is that the basal empty bracts of the racemes are hairy on both surfaces.

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Arboretum Activities

(*Continued from Page 58*)

Magnolia Registration

At the XVIth International Horticultural Congress, held in Belgium in September, 1962, the Morris Arboretum was officially designated as the International Registration Authority for Cultivar Names in the genus *Magnolia*. This means that the compilation and registration of names which has been conducted here for several years on a national basis is now extended to all countries. Anyone desiring to register new names in *Magnolia* should write to the Arboretum for application blanks.

Operation Blacktop

In line with the policy of gradually replacing our ancient gravel roadways with hard-surface ones, we are pleased to report that we have this fall completed a section of approximately 1000 feet extending from the Lodge House to the corner of Germantown and Hillcrest Avenues.

Fall Planting

Favored by excellent weather conditions, the autumn of 1962 has witnessed unprecedented activity in the moving of plants from lath-house, cold-frames and nurseries to their permanent positions on the grounds. As a result, substantial additions have been made to several of the larger families whose location on the area north of Northwestern Avenue has frequently been mentioned in these pages. They include the Saxifragaceae, Rosaceae, Leguminosae, Rutaceae, and others.

Several special projects have also gotten under way. One of these is the thinning out of a "jungle" on the south slope below the Gates Building, converting it into an attractive spot for some of the less hardy trees and shrubs. Another has been the cleaning out of the area known as the Cantilever Bridge, transforming it into a spot for such early-flowering plants as Daphnes.

By far the most ambitious undertaking has been the establishment of a fine collection of Cotoneasters in the vicinity of the Seven Arches. Here between the two roadways, as well as above and below them, some 90 small plants, representing over 50 different species and varieties have been set out. Within a few years this collection should constitute one of the most interesting features of the Arboretum.

J. M. F., Jr.

The Morris Arboretum Phlox Garden

Edgar T. Wherry

Although several familiar cultivated sorts of *Phlox* are herbaceous, most of the over 60 species which can be recognized in the genus[1] are more or less woody, and so are appropriate subjects for growing in an arboretum. Accordingly, when a modest sum of money was accumulated in payment for a brief lecture course in ecology presented early in 1962, a group of our Associates suggested that this be used to enable me to develop a special garden where members of the genus could be cultivated and studied.

A site for this was selected in Arboretum's grid-square E 18, at the southeast end of the greenhouse—coldframe area and the foot of the Wisteria-lined path below the Rose Garden. (Fig. 60). It has a moderately steep slope, facing southwest, partially though not too densely shaded by trees, with a medial flight of wooden steps, and a grassy path at the base. In order to make observation of small species practicable without excessive stooping, a professional mason was employed to build at the base a wall of local mica-gneiss rocks and portland cement made with dark gray sand, about 2 feet high and 1½ feet thick. (Fig. 61). To prevent this being used as a seat or as a children's runway, small pointed rocks were set in the top; to soften the effect of these, it is planned to train trailing sorts of *Phlox* to spread around them.

As most upland Phloxes grow naturally in well-drained, rocky situations, it was next in order to seek materials for constructing appropriate habitats. Fortunately, three sorts of rock proved to be available right on the Arboretum property, — limestone, sandstone, and mica-gneiss. Chips of the first two could be purchased from nearby quarries, while perlite, a granular pumice sold by horticultural supply houses, could be mixed with mica flakes and used with the gneiss. For planting, it proved practicable to dig out the dense, sterile subsoil of the site to a depth of 5 or 10 inches, insert both above and below rock slabs dipping into the hill, and fill in the interspace with soil mixtures. These were made up with loam, sand, compost or woodland humus, plus copious rock chips or grains to insure drainage. After each clump was planted, a half-inch layer of rock chips was spread on top, to lessen winter heaving and summer drying.[2]

Individual species are not being labelled, since the experience of rock gardeners with the public is rather disheartening. Younger members delight in pulling up labels and either resetting them in the wrong places, or carrying them off as souvenirs. Older ones check the literature and dig up for their own gardens any which are indicated to be rare or otherwise notable. Instead, the area has been divided into one-foot squares (the corners being marked by green-painted bamboo stakes) assigned letters from

Fig. 61. The Phlox Garden during construction; the Southeastern Division.

Fig. 60. Site of the Phlox Garden

[1] These are discussed in detail in The Genus Phlox, Morris Arobertum Monograph 3, 1955.

[2] It is a pleasure to acknowledge the help in the heavier construction work of members of the Arboretum staff; special thanks are also due Dr. J. J. Willaman, for aid in planting, rooting cuttings, watering during dry spells, and other ways.

bottom to top, and numbers from left to right. The names of the taxa occupying each square are being recorded in a card catalog and on a map, available to anyone interested.

The medial steps divide the garden into two parts. The Southeastern Division, that is, the one seen on the right as the slope is viewed from below, is devoted to taxa native to eastern and midland North America. It is constructed of sandstone rocks and chips, with some acid humus in the made-up soil. A band of large boulders has been set up the middle, to simulate a trap dike, such as traverses the strata further north along the Wissahickon Creek, separating areas occupied by two different *Phlox* groups. The Subdivision to the left of this is allotted to members of the long-styled group, comprising at the start *Phlox bifida, carolina, ovata, stolonifera* and *subulata*. In connection with the last, it may be remarked that the popular muddy magenta and crass crimson cultivars are to be strictly excluded, as they can be seen and admired (or otherwise) in many a sunny front yard.

Trees on the east and south borders of the right-hand Subdivision shade and desiccate the upper slope too much for present use, but at the base there is what is hoped will prove a suitable area for such short-styled woodland species as *Phlox divaricata* and *pilosa,* various unusual color-forms of which are being assembled. For these the soil is enriched with woodland humus, and leaf litter is allowed to accumulate on the surface.

The Northwestern Division, lying to the left of the steps as viewed from below, is divided into three parts, separated by foot-wide strips to be interpreted geologically as fault-zones, in that they lie between wholly dissimilar rock types. (Fig. 62). These zones are being left unplanted, to see which if any species may seed into them from either side. Of the three, the Right Subdivision, (like the Southeastern Division), is constructed with sandstone slabs and chips; this is planned to be occupied by relatively rare Phloxes, both eastern and western, including cultivars which seem to need more sunlight than they receive on the other side of the steps.

The Middle Subdivision is based on mica-gneiss rock slabs with granular material comprising mica flakes and perlite. This is intended to correspond to the native haunts of various western North American species, — high on slopes of mountains made up of volcanic debris or of massive igneous or metamorphic rocks. The

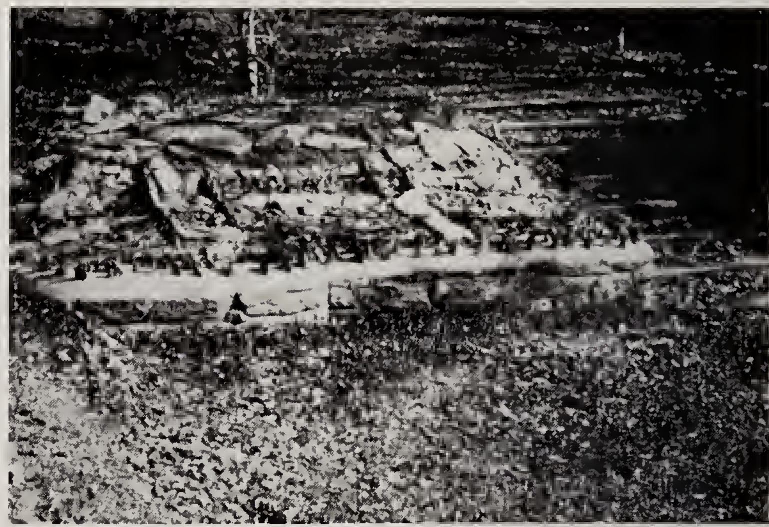

Fig. 62. The Northwestern Division.

species for planting here are being purchased chiefly from far western dealers, who grow them from cuttings taken from the wild clumps. Many of this group of plants may not be able to survive our climatic conditions, but are worthy trying anyway. Here has been set the tallest shrubby species, *Phlox speciosa,* which was discovered in Idaho by the famous Lewis and Clark expedition.

The Left Subdivision is built with limestone slabs and chips. It is to be devoted to western species which grow naturally in such formations, or in climates so arid that lime accumulates and neutralizes the soil whatever the substratum. Several of these have been obtained from western South Dakota, although they may not be able to withstand our humid summers.

In addition to *Phlox* itself, the Family Polemoniaceae comprises several other genera, and members of a few of these seem worthy of trial. A start has been made in the Northwestern Division of the garden with western species of the genus *Polemonium,* fascinating little plants with blue or less often yellow flowers. While these may come from alpine heights, they are reported to grow with moderate success in eastern lowland rock gardens.

It may be remarked, finally that most sorts of *Polemonium,* and for that matter not a few of *Phlox,* are offered by dealers under names which are not valid under the International Code of Botanical Nomenclature. One aim of the present garden will be to check the correct names of plants received; although whether it will prove possible to get these taken up by the trade is by no means assured.

Drought Injury

Patricia Allison

The realization that our concept of normal weather is based largely on monthly or annual means of periodic measurements made at Weather Bureau stations some distance from our homes is helpful in understanding the influence of environmental factors on plants. Even more helpful is the awareness that perennial plants themselves are continuously recording instruments that stand on the very plots of ground which command our interest. Data from their records are passed on to us in patterns of growth, flowering, and fruitfulness.

Each variety of plant continues to record its experiences of light, temperature, and moisture, so long as the capacity of its instrumentation, its heredity, is not exceeded. Just as certain thermometers break at a given temperature while others of different construction do not, so also are some plant species able to withstand weather experiences others cannot. These perennial botanical weather bureaus do not offer up yearly summaries of environmental factors, then begin all over again on January 1, because the weather of one calendar year continues to influence a plant's ability to interpret the weather of the next. A "drought year" for vegetation is real and damaging whether or not it begins in January and ends in December. Furthermore, the moisture records that plant reveals are not based on water caught in a vessel, a sample of that falling from the sky. Rather are they based on that moisture available to the root system, a sample of that in the ground. At the Weather Bureau, the size of the sample is measured in inches every time, and the length of the inch does not change. A plant, on the other hand, reports the adequacy or inadequacy of the sample according to how well it fills the moisture requirements at a particular stage of growth. How different can be the significance of an inch of rain in December from an inch in May to a plant!

The Current Drought

Botanical weather bureaus over a wide area of Pennsylvania reported, by means of their growth and appearance, a severe drought in 1962. One must examine more than annual precipitation records to find evidence of it in conventional Weather Bureau data, however. Table 1 summarizes Philadelphia Airport precipitation records for the last ten years. From annual totals, it is clear that 1954 and 1955 were dry. The drought of 1957, so damaging to plants, is also revealed in the annual total, the lowest since 1921. The years 1960 and 1961, however, are very close to the 47 year average of 41.20 inches, and 1962 so far is only 0.22 inch below normal. Where is the drought?

	Months												
Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1953	+	–	+	+	+	+	–	–	–	+	–	+	48.13
1954	–	–	+	+	–	–	–	+	–	–	+	–	34.04
1955	–	–	+	–	–	+	–	+	–	+	–	–	33.03
1956	–	+	+	–	+	+	+	–	+	+	+	+	46.00
1957	–	–	–	+	–	–	–	–	–	–	–	+	32.20
1958	+	+	+	+	+	+	+	+	–	+	–	–	47.87
1959	–	–	+	–	–	+	+	–	–	+	+	+	38.37
1960	–	+	–	–	+	–	+	–	+	–	–	+	41.15
1961	–	–	+	+	0	–	+	–	–	–	–	–	41.05
1962	–	+	+	+	–	+	–	+	–	–			

Table 1. Precipitation at Philadelphia Airport, 1953 to 1962. (+ signifies amounts above average; –, amounts below average for the month. Annual totals in inches.)

Note the sequence of dry months beginning in August, 1961. There are six. Only 1957 exceeded this during the last ten years with a series of seven dry months. To say that the current series was effectively broken in February, March, and April would be misleading, for the excess averaged less than half an inch a month. Some comments about the apparent abundance in June and August are also in order. The excess for June at the Weather Bureau was 3.35 inches; for August, 1.95 inches. Would not this abundance effectively break a widespread drought? Two facts reduce the impressiveness of these totals. The first is that 5.96 inches of the rain in June fell as downpours in three separate 24-hour periods. In August, 5.17 inches fell in three separate 24-hour periods. Downpours can be harvested from the sky and measured; they cannot always be sampled from the soil, simply because much of the water runs off the land rather than into it. Add to this the fact that summer storms are extremely limited in area. Many locations never received the downpours, and plants then continued to register "drought." Data from Robert Gall, an Arboretum Associate who maintains a weather station, illustrate this. One day in June, 2.34 inches fell at the airport, 1.42 inches at the

Gall station. On other days in June and August, the amounts were 2.61, 1.40, 2.21, 0.61, and 1.56 for the Weather Bureau, but 0.38, 0.08, 1.03, trace, and 1.93 at the other site, closer to the Arboretum. Indeed, there was a deficiency of 0.99 inches in June and a deficiency of 0.38 inches in August at the second site.

Symptoms of Drought Damage

Although wilting is by no means the first symptom of water shortage, it is one of the most obvious. The perennial woody plant, however, is a massive assortment of tissues not all of which go limp. This may be attributed to the stiff woody structure of some plant parts or to the unequal distribution of water within the plant. Wilting is confined to those tender parts, such as thin leaves, stem tips, and flowers. At first it occurs only during the hottest part of the day, but if the water deficiency persists, the normal turgidity of cells cannot be restored. The highest portions of the plant most distant from the main stem die first, then parts lower and closer to the stem. Segments of the root system fail. Midday wilting frequently goes unobserved on plants with stiff leaves or needles. Special methods are necessary to gauge the severity of internal water shortage. One such symptom in pines is a drop in oleoresin exudation pressure.

When drought is prolonged, but not yet critical, the water shortage causes changes in morphology of new growth. Tissues mature too early. Leaves may be distorted or stunted, twigs abnormally short. Flower buds may not open. The variation in width of growth rings in woody stems is common knowledge.

The severity of the symptoms mentioned varies, of course. Unfortunately, a relatively grave metabolic change may preceed the appearance of even mild wilting. These lead to complications.

Complications Arising from Drought

Pathologists and entomologists expect to be busier than usual following any widespread water shortage, for this type of deficiency casts long shadows into the lives of the trees and shrubs that survive. Drought changes the susceptibility of plants to their pathogens and pests. For the most part, the change is not in favor of the victim. The change may be swift and the attack immediate, so that century-old forests are decimated in a matter of weeks. *Pinus ponderosa* grows in relatively dry areas naturally. When, however, a rainfall shortage of only one inch for that region persists for two months during the active period, bark beetle susceptibility skyrockets. The first few beetles, usually males, bore into the bark. Their activity causes the emission

Fig. 63. *Prunus serrulata* killed by Crown Gall.

of fantastically attractive substances into the atmosphere that lead hordes of other beetles directly to the tree.

The lapse in resistance may permit only the first of a series of pests to begin work on a drought suffering plant, so that the last spring is postponed several seasons more. Oaks may fall prey to root disease fungi such as *Armillaria mellea* and then later to borers.

Another complication of drought must be included, for no matter how absurd, it is nevertheless real and important. The gardener feels compelled to water. This is very fine except when the compulsion drives him to put the wrong amounts of water on the wrong place at the wrong time. The notion is too widespread that a tree is like a telephone pole stuck in the ground, and that one must allow water to flow down its trunk to get to the base of the thing. The most common watering complication is, of course, the use of too little water too frequently. The effects of such practice go beyond the inducement of root proliferation near the soil surface where midday drying can cause death. Frequent sprinkling can provide some garden areas with the very moisture conditions that allow epidemics of disease characteristic of wet years rather than dry! *Vinca* blight is an example.

Case Histories

Mention was made of the continuing influence of a period of drought on the susceptibility of plants to disease and pests. It should also be said that trees and shrubs already weakened by such afflictions suffer first from the additional hazards of water shortage. Victims of the current dry period began to die in March. Among them were Rhododendron planted on dry slopes or injured by borers. Fall-planted stock could not survive unless supplied with additional water at crucial times in many locations. One garden was visited in which the separation of root ball from surrounding soil was the rule, not the exception. Several dozen *Rhododendron* were involved. Elsewhere, newly planted *Magnolia* trees in inaccessible sites could not be supplied with water enough to permit survival. Dogwood trees, able to struggle along with all but girdling basal cankers in past years, never bore a leaf this year. A magnificent elm, gracing an elevated lawn, died, not of Dutch elm disease, but because it could not survive the combined effects of the drought and the loss of a large portion of its root system when a new drive was constructed. In June, an uninjured Austrian pine, growing in a similar location, was observed as wilted as a pine can be. Prompt watering helped, but the borer story is yet to be revealed. During June and July, a number of elm specimens were examined for the fungus that causes Dutch elm disease. Only two of these were positive, despite the fact that the trees had certain symptoms of the disease. Evidence has just been published that the fungus activity is atypical during dry years. Early in July, a specimen of *Prunus serrulata* of moderate size died so quickly that every leaf remained attached, a highly uncharacteristic occurrence with a member of that genus (Fig. 63). The cause was clear. Massive root galls were visible at the soil surface even before the root system was carefully removed (Fig. 64). This plant cancer, Crown Gall, is caused by a bacterium. Nurseries supplying such stock cannot be certified by state or federal agencies for the production of certain crop plants, expected to be disease-free. Signs of various other root troubles became evident as the summer wore on. Oaks, long neglected on a certain site, suddenly were swamped with attention in the form of fertilizer, not water. Three applications within a year's time followed by drought cannot help but discourage the sturdy oak.

Premature color changes often accompany conditions resulting in limited water availability. Every year one part of a certain oak colors before the rest. A major root of this tree, probably supplying that portion of the crown, lies just under a break in the asphalt of a parking area. This year the color changes began in July. At the beginning of the same month, a *Liriodendron* turned pure gold, while its neighbor did not. Nearby stood another, dead. Later in the season, the discolored inner bark of the tree that bore the yellow leaves disclosed its probable fate-death by root pathogen in a drought year.

Not all of the symptoms observed were so serious. The new leaves of *Rhododendron,* for example, were so unusually pubescent that about a half dozen inquiries were received from worried gardeners.

Controlling Drought Effects

Disease, insects, injury, and faulty watering are not the only factors that intensify damage during dry periods. Other aspects of the weather that frequently accompany water shortage do so as well. High air temperatures and winds increase the rate of water loss from above-ground parts. Although elevated soil temperatures increase the rate of absorption, the temperature at which this increase ceases may be relatively low. The rate of absorption by sunflower, for example ceases to rise when soil temperatures reach about 70° F. Absorption may actually be suppressed, as in *Citrus,* when the temperature of the soil approximates 90° F. Other characteristics of soil such as clay and humus content affect its water retaining ability, and the concentration of salts influences the plant's absorption of water.

There are ways that such information can be utilized by the gardener in diminishing drought damage.

1. Selection of pest-free plants.
2. Controlling disease and insects after planting.
3. Avoiding use of drought-sensitive varieties on south and southwest slopes.

Fig. 64. Root system of *Prunus serrulata* killed by Crown Gall.

4. Improving water retention of soil with organic and clay amendments.

5. Mulching to reduce water loss and compaction, and to maintain moderate soil temperatures.

6. Pruning and shading newly planted shrubs to reduce water loss from tops.

7. Applying large quantities of water slowly and infrequently when a serious shortage exists.

The above discussion has not mentioned the complication of drought that is the most dreadful of all. This is the loss of the land itself. Earth made bare by death of plants cannot accept the rain that falls, but moves, a liquid desert, with the flood to shroud a wood or sediment the sea.

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Associates' Corner

Master Builder

On July 1, 1962, Mr. Thomas J. Carney retired from active service, after having devoted more than twenty years of his life to the Arboretum.

In 1941 Mr. Carney, who was a general contractor with a fine reputation, was employed by the Arboretum to renovate its greenhouse system. This included dismantling an antiquated unit and replacing it with a modern greenhouse equipped with adequate propagation and research facilities. It included the construction of a two-story stone head-house, providing offices, a small laboratory, an elegant potting shed, a tool-storage room and headquarters for members of the staff. It also included a complete rehabilitation of the heating plant in order to provide sufficient heat for the enlarged facilities.

All of this Tom Carney did almost single-handed proving himself to be at once a mason, a carpenter, a cabinet maker, a machinist, a plumber and an electrician. Such a master of all trades was too good to lose and, fortunately for the Arboretum, Tom was persuaded to accept a full-time job as a member of the staff. There has never been any lack of opportunity for the demonstration of his skills and the following are just a few of his accomplishments:

The renovation in 1946 of a section of the old Grist Mill and of the Miller's house, so that the latter was again made livable. It is now occupied by our Head Gardener.

The construction, in 1947, of the lath house or shade house, a model of its kind, which permits the seasoning of young plants of azaleas, rhododendrons and others, before transferring them to their permanent positions outdoors.

The metamorphosis of the old fish-hatchery on the farm into a fine residence for our present Superintendent, Mr. John Dourley, who joined the staff in 1956.

The complete reconstruction in 1957, of the roof of the tropical fern-house, which had become so dangerously weakend that it was necessary to close this fascinating structure to the public. This was a major triumph for Tom. A commercial greenhouse firm had rendered an estimate of $12,000 for materials alone to complete this job. Our builder "allowed" as how he could do the same thing for only about half of this amount — and he did!

The creation of a functional laboratory for our pathologist, Dr. Allison. This included the installation of sink, autoclave and constant temperature equipment, as well as the building of shelves and cabinets.

In addition to all of these were such "minor" tasks as putting a new roof on the barn, installing a dark room in Gates Hall, creating rest rooms out of a stone hovel at the Recreation Area, putting a new roof on No. 2 Greenhouse, putting a new heating plant in the garage, and keeping the Arboretum's heating, plumbing and electrical operations at a top level of operational efficiency. In everything that he has constructed Tom's motto has been, "Do it so well that it won't have to be done again for another lifetime."

Although he is officially retired, Tom Carney seems unable to detach himself from the Arboretum and we are happy to state that almost any day he may be found working at some job around the place, forging another testimony to his genius as a master builder. May he continue to do so for many moons to come!

Marion W. Rivinus

Book Review

A New Garden Book

How to Control Plant Diseases in Home and Garden, written by Dr. Malcolm C. Shurtleff, published this year by the Iowa State University Press, is a valuable, moderately priced ($4.95) addition to the sophisticated gardener's library. A great deal of the author's professional experience has been as an extension plant pathologist. As such, his responsibility has been to offer disease diagnosis information and control advice to professional and amateur grower alike. As a state's chief interpreter of research findings to the person actually cultivating plants, an extension pathologist uses every communication technique possible. Thus Professor Shurtleff brings to the compending of this volume a thorough knowledge of the variety of aid available from governmental agencies, and a wealth of experience in organizing its presentation to the public.

The book is designed for us by the amateur; it therefore omits detailed consideration of the pathogens and relies instead on discussion of the symptoms evident to the gardener. One man, asked to look the book over, reported, "Common terms are used — an admirable feature for dirt gardeners." Backing up the symptom descriptions, is a good general discussion of the extent, classification, and causes of plant diseases, followed by descriptions of many common types of diseases. These are arranged in broad categories based on the part of the plant affected. Thus the person in search of help might consult this well marked section of the book first if he desires.

The body of the work is an alphabetical listing of host plants, with their principal maladies. In order to avoid the reiteration of symptoms for each of a related group of species that are susceptible to the same pathogen, many hosts are grouped together. The reader first locates the plant desired, and then, if it shares troubles with relatives, he is referred to the appropriate group for the lists of diseases and symptoms, or to the general section mentioned above.

The illustrations in the book are superb for the most part. Liberal use has been made of the talents of Roger D. Albertson who possesses the knack of revealing in black and white sketches the characteristic symptoms often lost in photography. In addition to most of the illustrations, this reviewer especially appreciates the listing of resistant varieties where known, the detailed table of contents at the beginning of each section, the superior appendix that is much richer in information about seed and soil treatments than most books of this type, and the excellent glossary. The same cannot be said for certain of the illustrations and for the omission of a bibliography.

The objectionable photographs are used in the section about control measures. After adequate comments regarding safe use of pesticides, including the wearing of appropriate clothing, the portion of the chapter dealing with equipment is liberally illustrated with photographs from advertising copy of various manufacturers. No fewer than eight of these show people improperly clad for spraying or dusting.

The omission of at least a short bibliography of disease and insect books written by other professionals for home owners is regrettable. Although occasional references are made in the text, the section entitled, "Where you can get additional help," has nothing to offer between the agricultural extension service and "your florist, nurseryman, garden supply dealer," etc.

These criticisms notwithstanding, "How to Control Plant Diseases in Home and Garden" is welcome.

Patricia Allison

Library Accessions

Among the items which have been added to the Library during 1962 are the following:

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** Gift of Fred W. Schwoebel.

† Gift of William Logan Fox.

†† Gift of Dr. J. J. Willaman.

Index to Volume XIII

Nos. 1-4, inclusive (1962)

Errata

Page 15, line 19 (r) for constitutents read constituents
Page 15, line 37 (r) for vasodialator read vasodilator
Page 17, line 14 (r) for secretary read secretory
Page 35, line 25 (l) Dioscordies read Dioscorides
Page 36, line 55 (l) for carmimative read carminative
Page ?6, line 25 (r) for principal read principle
Page 36, line 33 (r) for principal read principle
Page 37, line 33 (l) for sensitive read tensive
Page 37, line 32 (l) for principal read principle
Page 37 line 19 (r) for Knellin read Khellin
Page 37 line 22 (r) for Knellin read Khellin
Page 37, line 25 (r) for Knellin read Khellin
Page 37, line 26 (r) for Knelloyd read Khelloyd
Page 54, line 39 (l) for *globulous* read *globulus*
Page 54, line 35 (l) for quiet read quite
Page 55, line 59 (l) for antispetic read antiseptic

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Callicarpa americana

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

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Arboretum Activities

The Staff

On January 30 the Director addressed the Jefferson Medical College Faculty Wives Club on the topic, "The Search for New Drug Plants." On February 21 he gave an illustrated lecture on "Magnolias" as one of the Winter Lecture Series of the Massachusetts Horticultural Society in Boston and on March 7 he spoke to the Bala-Cynwyd Garden Club on the subject "New or Unusual Plant Materials."

Dr. Li has finished reading proof on his forthcoming book, "The Origin and Cultivation of Shade and Ornamental Trees", and is in the final stages of proof-reading his "Woody Plants of Taiwan." Both volumes will appear as Monographs of the Morris Arboretum.

Dr. Allison presented one of the evening series of lectures of the Pennsylvania Horticultural Society on Wednesday, January 16. Her subject was "Many are the Ways of Pest Control."

On February 18 Mr. Dourley gave an illustrated talk on "Medicinal Plants" to The Planters' Garden Club at Gladwyne, Pa.

(Continued on Page 17)

Hardy Species of Callicarpa

Hui-Lin Li

Plants of the genus *Callicarpa,* as the name implies, bear beautiful, brightly colored fruits. They are sometimes called Beauty-berry. The cultivated species are deciduous shrubs with small pinkish flowers which are produced in attractive-looking clusters. However, it is the unusual color of the fruits that make these plants stand out distinctively as a group of desirable ornamentals. The individual fruits are small berry-like drupes of various shades of violet or sometimes pink or even white. They are produced freely in the autumn in dense or loose small clusters on the slender branches, presenting a colorful sight to the autumn scenery.

The genus *Callicarpa,* of the Verbenaceae or Vervain Family, is primarily of the tropics or subtropics. There are altogether about 40 species distributed in the Old World from Australia through Malaysia to eastern Asia and in the New World from Central America to southern North America. A technical account of the genus is given by Moldenke 1936. Only a few species are native to the more temperate regions of both hemispheres and these species are the ones that are in cultivation in our gardens. There are four such hardy species from eastern Asia and one, a more tender species, from southeastern North America.

The single native species of temperate North America, *C. americana,* has a natural range extending from the West Indies to Texas and northward to Virginia. In eastern Asia, the number of species is greater and also they extend further north to more temperate regions as western and central China, Korea and Japan. All of the hardy cultivated species, with the exception of *C. mollis,* which may not be at present in actual cultivation in the U.S., are represented in the collections of the Morris Arboretum. Besides these hardy species, several other more tender species from southern Asia are sometimes grown as greenhouse plants.

Species of *Callicarpa* are shrubs or trees. The temperate species are all shrubby. The leaves are deciduous, opposite and toothed. The young shoots and leaves are often covered with stellate hairs. The flowers are small with short-tubular, 4-toothed corolla, which is pink, white or sometimes bluish and glabrous or hairy on the outside. There are four stamens of equal length. The single pistil has a 4-celled ovary, a slender style with a simple small stigma. The ovary-cells are 1-ovuled. The fruit is a subglobose berry-like small drupe with 2-4 stones.

Among commercial nursery stocks and other cultivated materials, there seems to be some confusion in the naming and identifying of the various species. The hardy Asiatic species, while readily differentiable by floral and detailed vegetative features, are outwardly quite similar in general appearance. This is further complicated by the fact that there is often wide variation in leaf size, not only among plants of the same species, but often also on the same plant. Shoots sprouting from the base usually flower and fruit in the same year, and these seemingly mature shoots, nearly always bear much larger leaves.

The few keys to the hardy cultivated species in published works have not always proved to be satisfactory in actual use for identification because they are either incomplete as to the number of species treated, or they may call for both vegetative and floral features which are not always available together. In some cases, certain obscure features, such as hairiness of the young shoots, are used for differentiation. Among the more standard reference works, Rehder (1940) and Blackburn (1952) both give a key to four of the species. In Bean (1950) three species are given and no key is provided. Krüssmann (1960), a recent work in German, furnishes a key to five species together with illustrations. His illustration of leaves (*tafel 72*) of four of these species (two represented each by a variety only) is a most useful graphic treatment of this group of plants. However, in another figure, *Abb. 147,* a sketch of a flowering branch of *C. Bodinieri* var. *Giraldii,* redrawn after Eiselt, does not seem to have depicted accurately the leaf shape of the variety or the species.

In the present account, two keys are provided for the identification of the five hardy cultivated species, one constructed primarily on obvious leafy features and a separate one based on reproductive characters. Further to facilitate identification, illustrations of the leaves of these species and their important varieties as well as brief descriptions of these are also given.

Callicarpa americana stands out distinctly

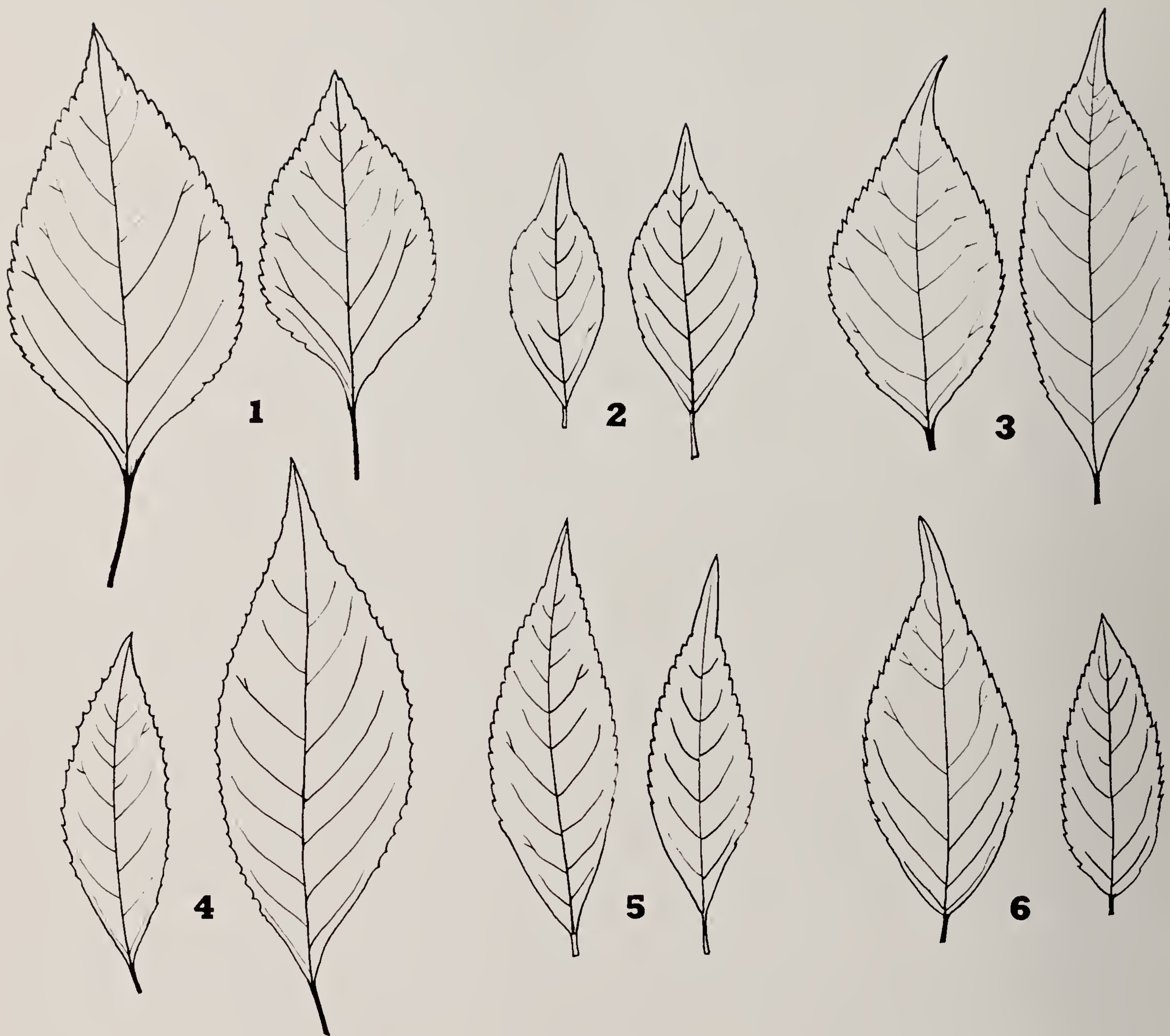

Fig. 1. Leaves of hardy Callicarpas (× ½).

from all other species by its long-petiolate leaves with crenate-serrate margins and by its nearly sessile flower and fruit clusters. Among the other species, leaf-shape, leaf-margins, and hairiness on stems and leaves furnish, especially in combination, reliable characters for differentiation. The leaf-margins vary from crenate-serrate as in *C. americana,* in which the teeth are more or less rounded, to dentate and serrate or denticulate and serrulate in others, where the teeth are pointed, either outwardly or forwardly. These teeth may occur along the entire length of the blade or they may be limited to the central portion only, as in *C. dichotoma* and *C. japonica.* In certain cases, the relative sizes of the leaves, within a certain range of variation, are also of importance. Various reproductive features provide more reliable technical characters for species differentiation.

I. Key to the species based on Vegetative Characters

A. Leaves long-petiolate, the petioles 1-3 cm. long, or about 1/3 to 1/5 the length of the blade, the margins crenate-serrate
1. *C. americana*

AA. Leaves short-petiolate, the petioles 2-15 mm. long, or about 1/5 to 1/20 the length of the blade, the margins serrate or serrulate to dentate or denticulate

B. Leaf base narrowly wedge-shaped; leaves glabrous to pubescent beneath
  C. Leaves glabrous or nearly glabrous, the margins serrate to serrulate more less toward the central part only
    D. Leaves elliptic or obovate, smaller, about 1.5-3 cm. long, rarely to 5 cm. or more, acuminate
    2. *C. dichotoma*
    DD. Leaves elliptic or ovate-lanceolate, larger and narrower, about 2.5-6 cm., sometimes up to 12 cm. long, long-acuminate ...3. *C. japonica*
  CC. Leaves pubescent on both surfaces, the margins dentate to denticulate or crenate-denticulate throughout the whole length ....4. *C. Bodinieri*
BB. Leaf base rounded or subrounded; leaves thickly stellate-tomentose beneath
5. *C. mollis*

Fig. 2 *Callicarpa dichotoma* in flower.

II. Key to species based on Reproductive Characters

A. Flower and fruit clusters sessile or nearly sessile ....1. *C. americana*
AA. Flower and fruit clusters peduncled
  B. Flower and fruit clusters glabrous; peduncles longer than the petioles
    C. Fruit smaller, about 3-4 mm. across; anthers opening by a slit; inflorescence generally supra-axillary
    2. *C. dichotoma*
    CC. Fruit larger, about 4-5 mm. across; anthers opening by a terminal pore; inflorescence axillary ..3. *C. japonica*
  BB. Flower and fruit clusters pubescent; peduncles about as long as the petioles
    C. Fruit bright purple, about 3-4 mm. across; flowers lilac, the stamens exserted ....4. *C. Bodinieri*
    CC. Fruit dull purple, about 5 mm. across; flowers light purplish rose, the stamens included ....5. *C. mollis*

Fig. 3 *Callicarpa dichotoma*, a fruiting branch.

1. *Callicarpa americana* Linn.

A shrub 1-2 m. high, with scurfy, downy tomentum. Leaves elliptic-ovate, 3-6 cm. long, the apex acuminate, the base cuneate, the margins crenate-serrate, pubescent above, white-tomentose beneath; petioles slender, 1-3 cm. long. Cymes very short-stalked, dense and many-flowered, shorter than the petiole; calyx obscurely 4-toothed; corolla bluish, glabrous; stamens exserted, with the filaments longer than the corolla lobes. Fruit violet or pinkish, about 4 mm. across. (Cover, Fig. 1-1).

The American Beauty-berry, sometimes known as French Mulberry, is one of the handsomest Callicarpas in fruit, but it is more tender than the Asiatic species. In its native habitat, it is found in rich woods and thickets from Florida to Texas, north to Maryland, Tennessee, Arkansas, and Oklahoma (Fernald 1950). The cover illustration is taken from its natural habitat in Virginia.

The plant flowers from May to July and bears ripened fruits around October. There is a variety *lactea* (*alba*) with white fruits, which are very

Fig. 4. *Callicarpa japonica* (Courtesy of the Arnold Arboretum)

Fig. 5. *Callicarpa japonica* in fruit.

conspicuous in fall and early winter. Because of its tenderness, it is rarely found in cultivation in the northern states. Rehder (1940) gives 1724 as the date of its introduction into cultivation.

2. *Callicarpa dichotoma* (Lour.) Koch
(*C. purpurea* Juss.)

Shrubs, 1-1.5 m. tall, the branches scurfy stellate-pubescent. Leaves elliptic or obovate, 1.5-3 (sometimes to 5 or more) cm. long, the apex acuminate, the base cuneate, the margins crenately serrate above the middle, entire toward the base, green and glabrous above, pale and glandular beneath; petioles 2-4 mm. long. Cymes mostly supra-axillary, peduncled, few to many-flowered, to 2 cm. across, the peduncles about 1 cm. long; calyx about 1 mm. long, minutely 4-toothed; corolla lilac-pink, about 2 mm. long; stamens exserted, the anthers opening by a longitudinal slit. Fruit violet, globose, about 3-4 mm. across. (Fig. 1-2, 2, 3).

This species is native to Korea, Japan and central and southern China. It is perhaps the most widely planted species of *Callicarpa*. It flowers in August and fruits in around October through November. In its native habitat, it prefers moist places and grows especially abundantly at base of hills and along waters (Pei 1936, Makino 1951). It was introduced into western gardens around 1857 by Robert Fortune. Lindley (1859) recorded the first fruiting plant in exhibit at the autumn 1858 meeting of the Horticultural Society in St. James' Hall in London, "excited more interest" than any other plant.

This species is closely allied to *C. japonica*, another commonly cultivated species, but is smaller in every respect. The characters that especially distinguish it from the latter are the young branchlets being slightly grooved or angled, the smaller less acuminate leaves with fewer but more forward-pointing teeth along the margins, the distinctly supra-axillary inflorescence, and the smaller flowers with the anthers dehiscing by a longitudinal slit instead of an apical pore. It is also less hardy as in its original home it is generally of a more southern range.

3. *Callicarpa japonica* Thunb.

Shrub, to 5 m. tall, the branchlets finely cinereo-tomentulose at first, soon becoming glabrous. Leaves elliptic or ovate-lanceolate, 2.5-6 (sometimes up to 12) cm. long, the apex long-acuminate, the base cuneate, the margins serrulate from near the middle upwards, green or dark green above, paler and glandular-hairy beneath; petioles 2-4 mm. long. Cymes axillary, many-flowered, about 1.3-3 cm. long; calyx 1-1.5 mm. long, shallowly 4-toothed; corolla lilac-pink or whitish; stamens exserted, about 6 mm. long, the anthers opening by an apical pore. Fruit globose, violet, glossy, about 4-5 mm. across. (Fig. 1-3, 4, 5, 6).

This species is widely distributed in Korea and Japan, where it is a common deciduous shrub of the hills. It flowers in August and fruits in October through November. According to Rehder (1940) it was introduced into western gardens in 1845. This date probably refers to the introduction of this plant to Holland by Siebold in 1844-45.

In cultivation there is a variety *leucocarpa*, with white flowers and white fruits. Another variety, *angustata* Rehder, differs from the typical form in its narrower leaves (about 5-12 cm. long and 1.2-3.5 cm. broad). It occupies, however, a distinct geographical area, in central to northwestern and western China. It is a small shrub to about 1.5 m. tall with pink flowers and rosy purple fruits. It was found growing in thickets at 1000-1500 meters in western China by E. H. Wilson in 1900 and again in 1907 (Rehder, 1917). It resembles somewhat *C. Bodinieri* var.

Fig. 6. *Callicarpa japonica*, fruiting branches.

Fig. 7. *Callicarpa Bodinieri* var. *Giraldii* in fruit.

Giraldii of the same general area especially in the more narrow-leaved glabrescent forms of the latter, but it is differentiated by the more oblong anthers opening by a pore at the apex as well as by the smaller but longer-stalked inflorescence.

4. *Callicarpa Bodinieri* Lévl.

Shrub to 3 m. tall, the branchlets scurfy-pubescent. Leaves broadly elliptic to elliptic-ovate or oblong-lanceolate, 5-12 cm. long, the apex acuminate, the base cuneate or broadly cuneate, the margins dentate to denticulate, slightly pubescent above, stellate-pubescent beneath; petioles 5-15 mm. long. Flowers in dense axillary cymes 2-3 cm. across, the peduncles pubescent, as long as or shorter than the petioles; calyx shortly toothed; corolla lilac-pink, the lobes rounded; stamens about 7 mm. long, exserted. Fruit globose, bright purple, about 3-4 mm. across. (Fig. 1-4).

The species is native to central and western China. It grows in thickets of the hilly districts but does not seem to be common. It flowers from July to September and fruits in September and October. The species is readily distinguished by the dentate margins of the leaves.

A variety, var. *Giraldii* (*Giraldiana*) Hesse, sometimes treated as a species *C. Giraldiana* Hesse, (Stapf 1916, Pei 1936) is native to central, western and southern China. It has not only a wider range than the typical *C. Bodinieri* but it is also a more common plant. In cultivation, it is also a commoner and more ornamental plant. It was first introduced into the western garden in 1900 (Stapf 1916, Rehder 1917).

Callicarpa Bodinieri var. *Giraldii* differs in the leaves being glabrous above and only sparingly pubescent beneath. The inflorescence is also less pubescent. The teeth along the leaf margins are crenate-denticulate and not distinctly dentate as in the typical form of *C. Bodinieri*. (Fig. 1-5, 7).

5. *Callicarpa mollis* Sieb. & Zucc.

Shrub, 2-5 m. tall, much branched, the branchlets densely stellate-tomentose. Leaves obovate-elliptic to oblong-lanceolate, the apex acuminate, the base rounded, the margins serrulate, sparsely tomentose above, stellate-tomentose beneath, glandular on both surfaces; petioles 3-10 mm. long. Cymes axillary, short-peduncled or nearly sessile, densely flowered, the peduncles as long as the petiole, stellate-tomentose; calyx deeply 4-lobed, stellate-tomentose; corolla lilac-pink, glandular outside; stamens not exceeding the corolla lobes. Fruit globose, dull purple, about 5 mm. across. (Fig. 1-6).

This species is native to Japan and Korea. It was first introduced by Richard Oldham in 1861-63 to Kew. It is still raised at Kew in a sheltered spot but is not as hardy nor as handsome as *C. Bodinieri* var. *Giraldii* (Bean 1950). It is not certain whether the plant at present is in cultivation in America.

This species is readily distinguished from the other species by the dense growth of stellate pubescence on nearly all parts of the plant and the wide rounded leaf base.

A hybrid between *C. mollis* and *C. japonica* is called *C.* × *shirasawana* Makino. It occurs naturally around Tokyo (Nakai 1922). It has elliptic to ovate-lanceolate or ovate-oblong leaves which are serrate along the margins and sparingly fasciculate-pubescent and glandular beneath. The calyx is distinctly lobed and the flowers lilac in color.

A small plant of this hybrid is represented in the Morris Arboretum collection.

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The Butterflies of the Morris Aboretum

Arthur M. Shapiro[1]

Lepidopterists have long been aware that the Delaware Valley is uniquely endowed with a very rich butterfly fauna. The large number of species which occur in the area are clearly divisible into endemic species, which tend to have relatively stable, conservative populations, and species derived from Canadian-Alleghenian and Upper Austral faunal sources, whose populations tend to be unstable and dissipative. There are also species which occur rarely in the area, as marginal strays; in this case, there is no consistent breeding locally, and the species are properly called non-resident. With the exception of this last category, the occurrence of any given species in a particular area is dependent largely on the specific environmental conditions present. It is principally the wide variety of micro-environments in the Morris Arboretum that is responsible for the wealth of species of butterflies present there.

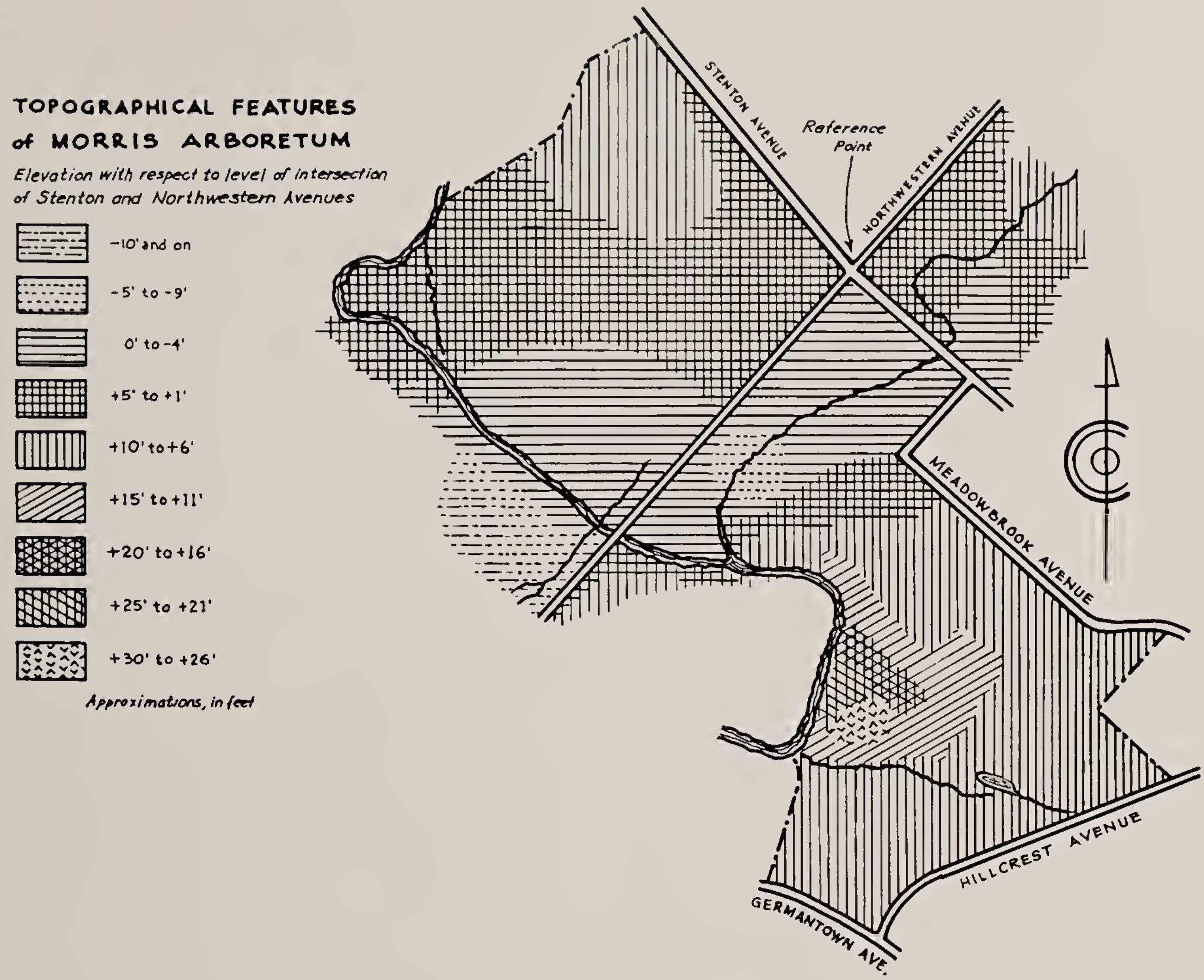
The predominant topographical feature of the Arboretum which contributes to this condition is the gradual slope downhill which runs from southeast to northwest. Geologically, this represents a transition from a predominantly quartzite to a limestone formation, and the basin-like effect achieved by the upslope which begins gradually again at the extreme northwestern boundary of the Arboretum, and the more pronounced one to the southeast, superimposed on a limestone base, has contributed to the accumulation of standing water and poor drainage in a general way. In a broad band extending from the property of the Mt. St. Joseph Academy across Stenton Ave. and Northwestern Ave. to the Wissahickon Creek on the southwest and the Whitemarsh Valley Country Club to the west and northwest ,the vegetation has assumed a distinctly damp-ground character. Here occur a number of the most interesting butterfly species of the Arboretum. This broad area has been designated Area 1 for the purposes of this study, and has further been sub-divided into sections based on slight but significant environmental differences. (Fig. 8) . Section 1 (a) lies to the northeast of Stenton Avenue, on the Mt. St. Joseph property. It is characterized by the following plants: Star Thistle, *Centaurea maculosa;* Tall Beggar-Ticks, *Bidens frondosa;* Swamp Milkweed, *Asclepias incarnata,* with some Common Milkweed (*A. Syriaca*); Red Clover (*Trifolium pratense*) ; a number species of the genus *Erigeron; Polygonum pennsylvanicum, P. lapathifolium* and *P. acre*. Section 1 (b) is directly across Stenton Ave. and represents a slightly wetter condition. It has been literally taken over by the Blue Violet, *Viola papilionacea,* which has formed a dense undergrowth along with Red Clover and an expanding stand of Orange Hawkweed, *Hieracium aurantiacum*. Along the edge of the principal stream a good growth of Goldenrod (*Solidago canadensis*) , Swamp Milkweed, small Willows (*Salix nigra*) , and Jewel Weed (*Impatiens biflora*) has developed. To the southeast of this stream, there is some decrease in the amount of *Viola,* a clump of *Hieracium pratense* is developing, and Curly Dock (*Rumex crispus*) , Chicory (*Cichorium Intybus*) , and Stinging Nettle (*Urtica*) begin to appear as the elevation gradually increases. Across Northwestern Ave., a similar condition exists, with the addition of a quantity of Ironweed (*Vernonia noveboracensis*) . This area has been shown on the map (Fig. 8.) as part of section 1 (b) .

Section 1 (c) is the small, nearly circular, marshy area south of Northwestern Ave., bounded by section 1 (b) and the stream flowing through it. There is a marked depression in the middle of this area, filled with a variable amount of water, the depth of which is dependent primarily on rainfall. In this usually shallow pool a good growth of Cat-tail Reeds (*Typha*) is in evidence, and under the shelter of the surrounding trees a dense mat of Japanese Hop (*Humulus japonicus*) , Jewel Weed, and various Asters and Erigerons has developed. This area is normally above water but is partially inundated after a heavy rain. Where the stream begins to loop southward, in approaching the Wissahickon Creek, there is a dense stand of Common Milkweed (*Asclepias Syriaca*) . This is one of the principal congregating places for the strong-flying species of butterflies.

Area 2 consists of all of the closely-cropped lawns and open, cultivated parts of the Arboretum. It is thus split in two by Area 1, as shown on the map. The fewest species and individuals of butterflies occur here.

Area 3 comprises the wooded sections of the quartzite region in the southeastern part of the Arboretum. It extends from the Wissahickon

[1] The author, a senior at Philadelphia's Central High School, recently won the second prize (a $6000 scholarship) in the annual Westinghouse Science Talent Search in a field of 22,000 entries.



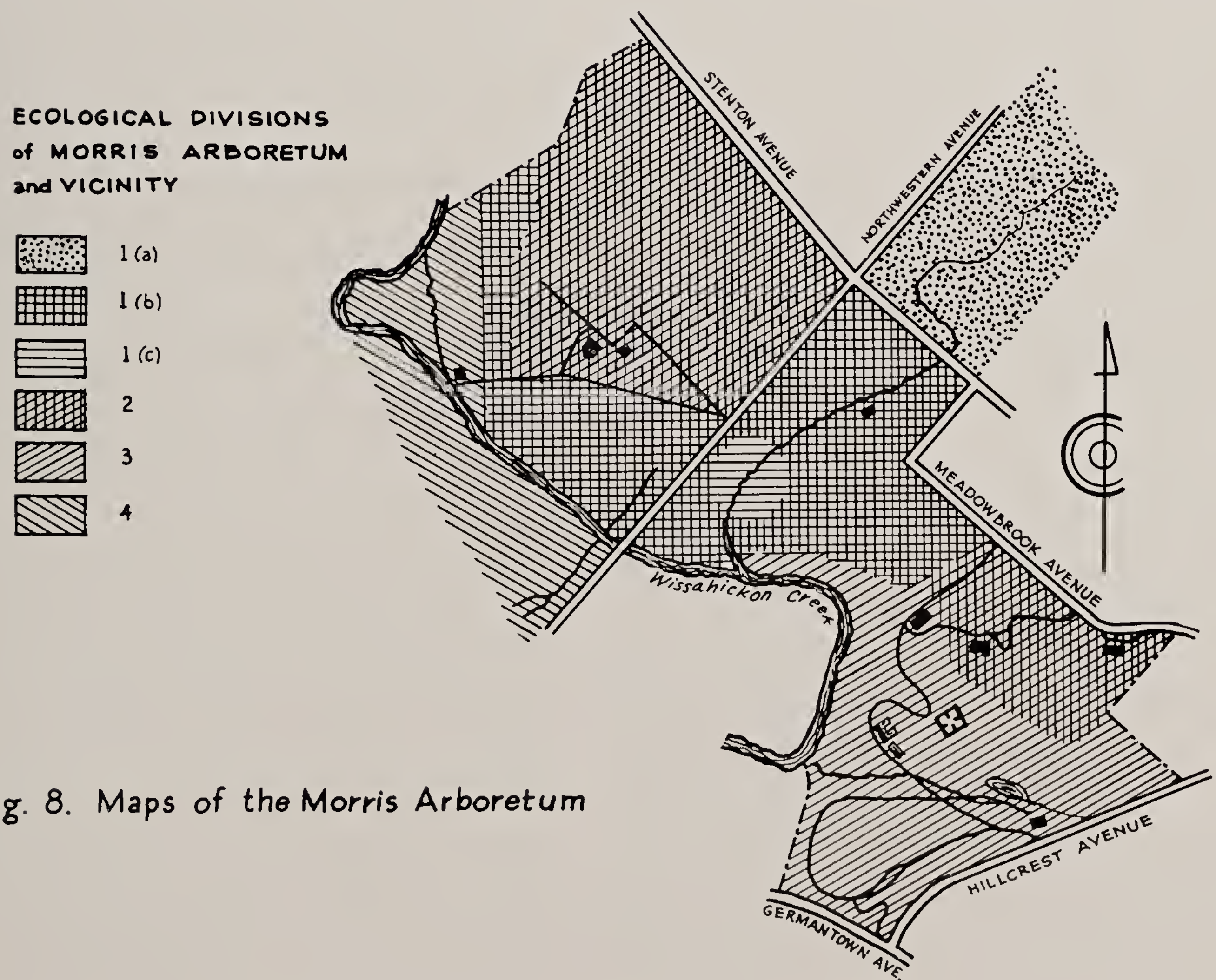


Fig. 8. Maps of the Morris Arboretum

to the Greenhouses and the Medicinal Garden, Azalea, and Rhododendron plantings. A number of excellent species occur in this region. Characteristic plants of the cliff region along the Creek are Hemlock (*Tsuga canadensis*), Chestnut Oak (*Quercus Prinus*), and Black Birch (*Betula lenta*), all typical of the Alleghenian flora; hence, it is not surprising that the butterflies of this region are also typically Alleghenian. A little further up, with the soil becoming more acid and a more heterogeneous growth becoming in evidence, with a mixed undergrowth of Spicebush, May Apple, and English Ivy (*Hedera Helix*), a number of butterfly species characteristic of mixed deciduous Transition Zone forest are found.

Going back across Northwestern Avenue to the southwestern part of the Arboretum, a very fascinating area extends from the northern edge of the Wissahickon and the edge of the cultivated, close-cropped Country Club, southwestward to the Wissahickon Hall hospital grounds. Down in this section, much of the original woodland remains, curiously mixed with an unusually diverse and chokingly thick adventitious growth of such plants as Japanese Hop, Indian Hemp (*Apocynum cannabinum*), Stinging Nettle, Ironweed, and various Goldenrods and Sunflowers. This area is traversed by meandering streams closely bordered by dense growth of *Polygonum acre, P. Persicaria,* and *P. Hydropiper,* with the entire depression being inundated frequently following heavy rains, often to a considerable depth. Where the trees remain, a few plants of *Vaccinium* and a certain amount of Japanese Honeysuckle (*Lonicera japonica*) occur as undergrowth. The soil in this basin is quite rich as a result of alluvial deposits, and the phenomenal growth of the crowded flora makes it difficult to navigate when collecting in this area. A number of scarce butterflies occur in this highly singular environment, which has been designated Area 4.

Having now considered the general topography of the Arboretum and how it affects the butterfly populations, we are in a better position to understand the butterflies themselves and their relationships to their environment. Over sixty species of butterflies have been taken or seen at the Arboretum, a most respectable total indeed. Each of these will be considered briefly in the following pages, with information as to localities within the Arboretum where observed (constant references to the sections described above will be made), food plants, habitat associations, seasons of flight, and relative abundance. To increase the usefulness of this study, I have given, in parentheses, the page reference to the standard book on the subject, Klots' *Field Guide to the Butterflies,* for each species. The complete reference for this book will be found at the end of this article. The present study, in conjunction with the "Field Guide," should insure rapid and easy identification of all Arboretum butterflies. The species will be taken in the accepted taxonomic order, by families. It should be noted that description of abundance has been done on a subjective basis, in which density, localization, length of flight, and amount of search devoted to the particular species are all of prime importance. It should also be kept in mind that many species, especially those derived from nonendemic groups, tend to fluctuate widely in numbers from year to year; where such fluctuation is pronounced it has been specifically noted.

Family Satyridae

Lethe portlandia, Pearly Eye (66)

This is a very rare insect in the Philadelphia area. It has been seen only once at the Arboretum, July 2, 1962, in area 3. The butterfly was observed flying several feet above the ground in a very circumscribed area, where the trail paralleling the Wissahickon turns outward prior to merging into the Medicinal Garden area. It alighted several times on tree trunks but could not be captured. The food plants are reputedly various narrow-blade grasses.

Lethe eurydice, Eyed Brown (68)

A rather small colony of this local species was observed in 1962, apparently restricted to the marsh, section 1 (c), and the immediately adjacent parts of section 1 (b). Only one brood was observed, from June 6 through July 3. For the first two weeks of the flight period, only males were seen. The species is not uncommon in Montgomery County, but is quite local, and is a typical species of low, marshy situations. It is usually found in the type of situation where Cat-tail Reed (*Typha*) grows. Its flight is low and unsteady, and it is easily caught. The food plants are reputedly various marsh grasses, but the larva has not been observed at the Arboretum.

Euptychia cymela, Little Wood Satyr (69)

Although this is a very abundant species in much of Pennsylvania, and occurs quite commonly within five miles of the Arboretum, its occurrence there is apparently rather exceptional, and limited to a small colony in the woods and along the edge of the Azalea plantings in section 3. The species flies low, dodging in and out of the undergrowth in the dappled light and shade. The flight period is from late June to very early August at the Arboretum; as in the preceding species, the males appear fully two weeks before the females. There is only one brood. The larva has not been found at the

Arboretum, but is known to feed on a wide variety of grasses.

Cercyonis alope, Wood Nymph (72)

This is yet another species that is common throughout eastern Pennsylvania, but unaccountably scarce at the Arboretum. It has been taken five times in field 1 (a) and seen once in 1 (b). These records fit well into the general flight period for the area, which extends from late June through early September. Despite the long season, there is only one brood; the males appear two weeks or more before the females, then seemingly disappear a week after the females come out. These latter remain on the wing for a month or more. A female in section 1 (a), Sept. 5, 1961, is one of the latest records of this species in the county. The larvae are known to feed on Purple Top Grass (*Triodia flava*) in Cheltenham Township, but have not been found at the Arboretum.

C. alope is usually found in situations where considerable amounts of High Bush Blackberry (*Rubus allegheniensis,* in which the butterflies take shelter when alarmed) and Honeysuckle (*Lonicera*) occur. The conspicuous absence of these plants at the Arboretum seems to indicate that differences in soil chemistry or drainage not readily apparent to the eye may be responsible for the absence of the insect. At Montgomeryville, the species ocurs in a marshy meadow containing considerable standing water, with Elder (*Sambucus*) and *Polygonum* among the dominant plants; but both *Rubus* and *Lonicera* are also present in the drier parts of the field. This ecological problem deserves further study.

Family Danaidae

Danaus plexippus, Monarch (77)

As elsewhere in eastern Pennsylvania, the Monarch is a very common species at the Arboretum. It is most frequently seen in section 1 (a), where it breeds extensively on the Milkweeds (*Asclepias Syriaca* and *A. incarnata*) which abound there. As is well known, the species is migratory, and does not survive the winter here. The first stragglers from the south become evident at the Arboretum in late May or early June, and the species is present more or less continuously thereafter until early October. At least two broods are reared in the area, peaking in late June to mid-July and mid-August through September. The species begins to migrate southward by mid-September and generally disappears by mid-October. It has been taken or seen in every part of the Arboretum except the deepest part of the woods in section 3.

While *Apocynum* has been suggested as an alternative food plant for the species, and is common in section 4, I have never found the larvae on anything but *Asclepias* at the Arboretum.

This species is subject to fluctuations in numbers. It was scarce in 1959 and 1960, commoner in 1961, and very numerous in 1962, especially in September, at the Arboretum. It is one of the easiest of our large butterflies to catch and to rear.

Family Nymphalidae

Euptoieta claudia, Variegated Fritillary (85)

The Variegated Fritillary is a local species in the north. It has two strong breeding colonies in Philadelphia County where it survives the winter. One of these is at the Arboretum, in sections 1 (a) and 1 (b).

A southern species, *claudia* has in recent years extended its range northward and has now penetrated New York State. It was first found at the Arboretum in 1960, was very common in 1961, and less so in 1962.

There are three broods, late May to early June (small, very scarce), July, and mid-August through late October. There is considerable variation in size and pattern of individual specimens. The species is inordinately fond of *Centaurea* and *Asclepias* blossoms, and also visits Red Clover.

The food plants listed for *claudia* in the south are many and varied. The most likely candidate at the Arboretum would appear to be the Common Blue Violet (*Viola papilionacea*); the larvae have not been found. Other possible food plants are May Apple (*Podophyllum*), Stonecrop (*Sedum*), *Desmodium,* and Purslane (*Portulaca*).

Speyeria cybele, Great Spangled Fritillary (87)

This is a very common insect at the Arboretum, as throughout the State. It has been found in every part of the Arboretum, but is most often seen on the Milkweed along the stream, between section 1 (b) and in the woods in area 3. There is one brood, with adults flying from late June through early August; as in the Satyridae, the males appear from one to two weeks before their mates.

The very similar species, *S. aphrodite,* has been quite scarce in Philadelphia for three years and has never been taken at the Arboretum, although it may well occur there. Neither has the Regal Fritillary, *S. idalia,* which is partial to damp situations. It is a local species with the nearest colony twenty miles away at Norristown. If introduced, it would probably thrive at the Arboretum; and it would be a decidedly welcome and handsome addition to the fauna.

Boloria toddii, Meadow Fritillary (92)

This species has what is known as a "discontinuous distribution". It is local, but in its particular localities it has a tendency to develop tremendous populations, as it has done at the Arboretum. It has two established colonies in

the area, one at the Arboretum in areas 1 (b) and 1 (a), and the other at Mill Grove, Montgomery County. It occurs only very rarely elsewhere in the region, although there is some evidence of a third colony developing at Norristown as an offshoot of the Mill Grove stock.

At the Arboretum, the species fairly swarms during its peaks in late April to mid-May, July, and late August through mid-November; but occasional specimens may be seen almost any time during the warm season. The peak abundance was reached in September-October, 1961, and early May, 1962, at both of which times it was thoroughly possible to collect five hundred individuals in two hours. This extraordinary abundance is in part explained by the profuse growth of the food plant, the Common Blue Violet, in field 1 (b). It seems likely that a period of relative scarcity may follow this surge of abundance.

The species has a rather low, direct, strong flight, quite different from the similarly colored *Melitaea nycteis* which also occurs with it. It is subject to rather extensive variation, and females are invariably larger and paler than males. Melanic individuals, in which the black markings are more or less confluent, have been taken twice at the Arboretum.

Euphydryas phaeton, Baltimore Checkerspot (93)

The Baltimore is another local species, strongly restricted to marshy situations. It has been taken only once at the Arboretum, in area 1 (c) (naturally!), June 15, 1958, a male. There are several well-established colonies in Montgomery County, and the species has been taken twice in Cheltenham Township, about eight miles from the Arboretum. The food plant elsewhere is *Chelone glabra,* a plant which for some reason does not grow in the marsh today. Perhaps it formerly did and died out, resulting in the extinction of the butterfly colony. The larvae are gregarious and live in webs on the host plant.

Melitaea nycteis, Silvery Crescent (98)

This species has been found sparingly in section 1 (b) on both sides of Northwestern Avenue. Its flight is weak and rather erratic, and it is fond of sipping moisture from damp ground. Otherwise, it is much like *Boloria toddii* in appearance when on the wing, and may be mistaken for it. There are two broods at the Arboretum, in mid-May and early June, and again from late July through early September. The second brood is generally a more protracted, sparse affair. The food plant is *Aster novae-angliae* at the Arboretum; elsewhere the larvae have been found on various Asters and on *Actinomeris alternifolia.* It appears to be more or less in competition for food with the next species.

Phyciodes tharos, Pearl Crescent (100)

As in the case of *Cercyonis alope,* this is a species which is very common throughout eastern Pennsylvania, but decidedly less so at the Arboretum. It has been taken in all the open areas — 1 (a), (b), and (c), and 2, and is perhaps most frequent in section 1 (a).

There are four broods, the peaks being in late April-May, late June to late July, mid-August to September, and late October to early November. As in the case of the Meadow Fritillary, however, there is a tendency for individuals to emerge at odd times between regular broods. The food plants at the Arboretum are the following Asters, in order of the frequency with which larvae have been found on each species: *A. umbellatus, multiflorus, novae-angliae, patens,* and *ericoides.*

This species is subject to variation caused by temperature. The dark "cold weather" forms are relatively more frequent at the Arboretum than at most localities, probably as a result of the "basin effect" in which pools of cold air collect in low spots between hills. The results of such thermal subsidence in dry situations are sometimes very striking, and the greater production of "cold weather" forms of butterflies at the Arboretum is probably inhibited only by the presence of surface moisture, which makes the air cool to saturation very rapidly. Fog patches are frequent, and the dew extraordinarily heavy, in sections 1 (a) and 1 (b) especially; and if the moisture were not so pronounced it seems likely that much lower temperatures might be reached. The "cold weather" form of the insect in question has the dark markings on the hind wing beneath more or less enlarged, reddened, and confluent.

Polygonia interrogationis, Question Mark (102)

This species has been taken in two widely separated areas of the Arboretum, areas 3 and 4. As may be inferred from this choice, the Question Mark is essentially a woodland species. It is less common at the Arboretum than in Cheltenham Township and certain sections of northern Montgomery County; it is also subject to fluctuation in numbers, having been commonest in 1958 and 1962, and relatively scarce in between, the low point having been reached in 1960.

The butterfly has been found along the wood trails in area 3, sunning itself in clearings, and returning repeatedly to the same perch. The flight is very fast and erratic, and the underside coloring is of great concealment value.

The brood sequence is rather complicated, The adult butterflies hibernate in hollow trees and under loose bark, and appear in late March

(March 27, 1961) and early April along the trails. These butterflies are of the pale-colored form. In mid June their offspring, which are of a darker-colored form, begin to emerge, peaking in early July, and continuing intermittently into early August. In the meantime, the offspring of the earliest June butterflies mature and emerge as the dark form, beginning in August. In early September the later individuals of this second brood begin to appear as the light form, which peaks toward the end of September and continues to emerge through October. These are the butterflies which hibernate, and most of them take shelter almost immediately after emerging.

The most frequently utilized food plant at the Arboretum is Japanese Hop (*Humulus japonicus*). The larvae have also been found on False Nettle (*Boehmeria*) and Hackberry (*Celtis occidentalis*) in areas 3 and 4, respectively.

Polygonia comma, Comma (103)

The Comma is quite common at the Arboretum, in the same localities as its congener, the Question Mark, which it resembles very closely in life history and habits, as well. It also has both light and dark phases, and the brood sequence is nearly identical to the preceding.

In area 4 these butterflies have the habit of sitting among the vines of Japanese Hop, from which they may be startled by a sweep with the net. They also have been observed, apparently enjoying the sun, with wings outspread, on rocks overlooking the Wissahickon. The species is quite wary and difficult to catch.

The food plants at the Arboretum are *H. japonicus* and *Boehmeria*. It is also subject to fluctuations in numbers, and its period of maximum abundance in the last few years extended from the fall, 1961 to the early summer, 1962, brood.

Polygonia progne, Gray Comma (104)

This is one of several rare species which have been found at the Arboretum. It has been taken there twice, both times along the Wissahickon in area 4, Aug. 15, 1958 and Sept. 20, 1961. The brood sequence of this *Polygonia* is less complicated. Elsewhere in Pennsylvania there are known to be two broods; while only the second has been taken at the Arboretum, it is likely that the species conforms to character there. The September brood is believed to hibernate, as in the other *Polygonias*. The food plants elsewhere are reportedly various species of the genus *Ribes*.

All of the *Polygonias* are typical members of the Alleghenian fauna, and are associated with woodlands. The two *progne* taken at the Arboretum were both disturbed when sitting concealed on the ground or among low foliage, on the short path included in area 4 which connects area 1 (b) with the Golf Course. (See map.) The dead-leaf coloration of the closed wings is an admirable procryptic device.

Nymphalis antiopa, Mourning Cloak (106)

In normal years, the Mourning Cloak is fairly common at the Arboretum; in 1962 it was exceptionally so. This represented a very general upward trend in the populations of this species in eastern Pennsylvania. Individuals were taken in all areas, but in normal years the insect is more or less restricted to areas 3 and 4.

The Mourning Cloak is essentially a woodland butterfly, but it ranges more widely than the *Polygonias,* and is often on Milkweed blossoms at the Arboretum. As in the preceding three species, the adults hibernate, and appear on the wing in the woods of area 3 in particular, very early in the season, flying from mid-March through May. They have the habit of sunning themselves, with wings outspread, on the wood trails, and will return again and again to the same spot. Early spring individuals are usually bleached and ragged from their long hibernation.

The first brood of fresh adults flies in late June and the first half of July. These butterflies stray more to the fields than the hibernators, but many of them remain in the woods. The second brood is very inconspicuous and flies from August through October. Individuals of this brood are but rarely seen, and the question arises as to what happens to them. In New England a certain amount of aestivation has been observed, but here it seems likely that a large percentage of the pupae do not mature, but remain in that stage through the winter, emerging as butterflies in the spring. Fresh individuals are often seen in May in Montgomery County, but seldom at the Arboretum; so the problem remains somewhat a mystery. The food plants at the Arboretum are Willow (*Salix*) and Hackberry (*Celtis*); perhaps also Elm and Blackberry (*Rubus*) as elsewhere in the area. Two pupae were found on the door-frame of the building by the path alluded to under *Polygonia progne,* but both were parasitized.

Vanessa atalanta, Red Admiral (107)

This common insect, but none the less beautiful for its commonness, is found in every part of the Arboretum with the exception of area 2, the manicured lawns. Like the Mourning Cloak, it is essentially a woodland species, but often strays into the fields. It is very variable in numbers, and was especially common in 1957-58 and 1961.

In this species, it is definitely known that both adults and pupae hibernate. The overwintering butterflies appear in area 3 in the same situations

as the preceding species. They are shortly followed by fresh individuals from the overwintered pupae in early May. These are the butterflies which one may observe on the lilacs along the walks and in the Medicinal Garden. They are small and rather pale in comparison with summer specimens — a variation more likely correlated with moisture than temperature, according to some authorities. At any rate, the dark summer brood appears in mid-June and continues on the wing through mid-July, with the partial second brood in September. These two broods are widely-ranging and the insects are often seen in the fields, especially in section 1 (b).

The food plant of the species is stinging nettle (*Urtica*), which provides sufficient discouragement for most people from looking for the early stages.

Vanessa cardui, Painted Lady (107)

Since 1960 this species has been very scarce in Pennsylvania. One specimen was taken in area 1 (a) on Sept. 11, 1961. The food plants are a variety of common Composites and presumably there is nothing to prevent the species from "staging a comeback" when it manages to restore its population equilibrium. It was very common in 1958 and two were caught at the Arboretum in 1959 (July 17 and 23). The species is noted for its periodicity.

Vanessa virginiensis, Painted Beauty (108)

Happily, this beautiful butterfly is not subject to the fluctuations that characterize its very similarly colored relative. It is common in sections 1 (a) and 1 (b), and unlike the other Vanessas is strongly a denizen of open spaces. It is highly variable as to size and markings, however.

Both the pupae and adults hibernate. The latter appear in early May, and emergents from overwintered pupae follow closely in late May and early June. The offspring of the hibernating adults mature and emerge as butterflies in late June, and those from the group which emerged from the hibernating pupae follow in rapid succession, so that fresh individuals continue to appear well into July. The partial second brood occurs as scattered, fresh individuals from mid-August into mid-October.

The food plants are a varied lot of Composites, including Wormwood (*Artemisia*), Everlastings (*Gnaphalium, Antennaria, Anaphalis*), *Vernonia,* and Burdock (*Arctium minus*).

Precis coenia, Buckeye (109)

The Buckeye usually manages to survive our northern winters with a fair degree of regularity. It was apparently eradicated, however, in 1962, since not a single individual has been reported from the Arboretum or elsewhere in the county. It will be interesting to see if this southern species re-establishes itself.

In most seasons, *coenia* was fairly common in fields 1 (a) and 1 (b), generally in September. In better years the three broods all are represented: late May to June, late July, and late August to mid-November. The species is subject to considerable variation in size and color.

The food plant at the Arboretum was that ubiquitous weed, *Plantago Rugelii.* The species has not been found utilizing the similar, introduced *P. major* in eastern Pennsylvania.

(*To be Continued*)

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since December, 1962:

Mrs. Orin Burley
Mr. George Wood Furness
Mr. D. Todd Gresham
Mrs. Anne L. March
Mr. Henry C. Miller
Mr. Richard B. Montgomery
Mrs. H. C. Morris, Jr.
Phila. H. S. of Agr. & Hort.
Colonel Frank M. Steadman

The Preparation of Spruce and Hemlock Herbarium Specimens

Frank S. Santamour, Jr.
and
Harry C. Kettlewood[1]

An herbarium is a library of plant material. As such it can serve any of the general or specific functions of a regular library. A carefully planned herbarium is an indispensable working tool of the plant taxonomist and geneticist.

A genetics or plant program requires a special kind of herbarium. The geneticist is interested in the inheritance of individual characters determined by comparing the features of parents and progenies. Thus, the ideal genetics herbarium preserves material from every plant used as a parent and from a representative sample of every progeny. The slow development of forest trees often necessitates a considerable time lag between the actual breeding work and the final analysis of results. Although notably long-lived, the parents may die or be removed before their progenies develop sufficiently to warrant a parent-progeny comparison. Likewise, the numbers of individuals in certain progenies may be materially reduced by natural and artificial causes.

The standard herbarium techniques, known to most professional and amateur botanists, consist of collecting, pressing, drying, and mounting the desired plant segment for permanent reference use. The established methods are suitable for a majority of woody plants, gymnosperms as well as angiosperms, with only a few exceptions. Two of these exceptions are the genera *Picea* (spruce) and *Tsuga* (hemlock). A person consulting an herbarium for identification of species in these genera is confronted with a sheet comprised of a woody, branch skeleton accompanied by a packet containing the needles that were once attached to that branch (Fig. 9). The exact cause of the inability of these plants to hold their needles when dried is not clearly understood. To be sure, such specimens can be used for verification of unknown plants, but their usefulness is quite limited. For instance, the size and placement of needles at various branch positions cannot be determined.

[1] Geneticist and Research Technician, respectively, Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The Experiment Station's forest genetics research is conducted in cooperation with the Morris Arboretum of the University of Pennsylvania, Philadelphia, Pennsylvania.

The volume of work with spruce by the genetics project of the Northeastern Forest Experiment Station has made it imperative to maintain herbarium specimens of this genus for future use. Sixty-eight individual parent-trees of thirteen species have been used in hybridization studies. These studies have produced progenies from thirty-seven interspecific combinations, including reciprocals, and over 5600 trees have been established in test plantations from Maine to Maryland.

We have have felt a definite need for a method of preserving spruce material in a reasonably intact and natural state. So we tested and examined several possible methods and the findings are presented here. Our breeding program has

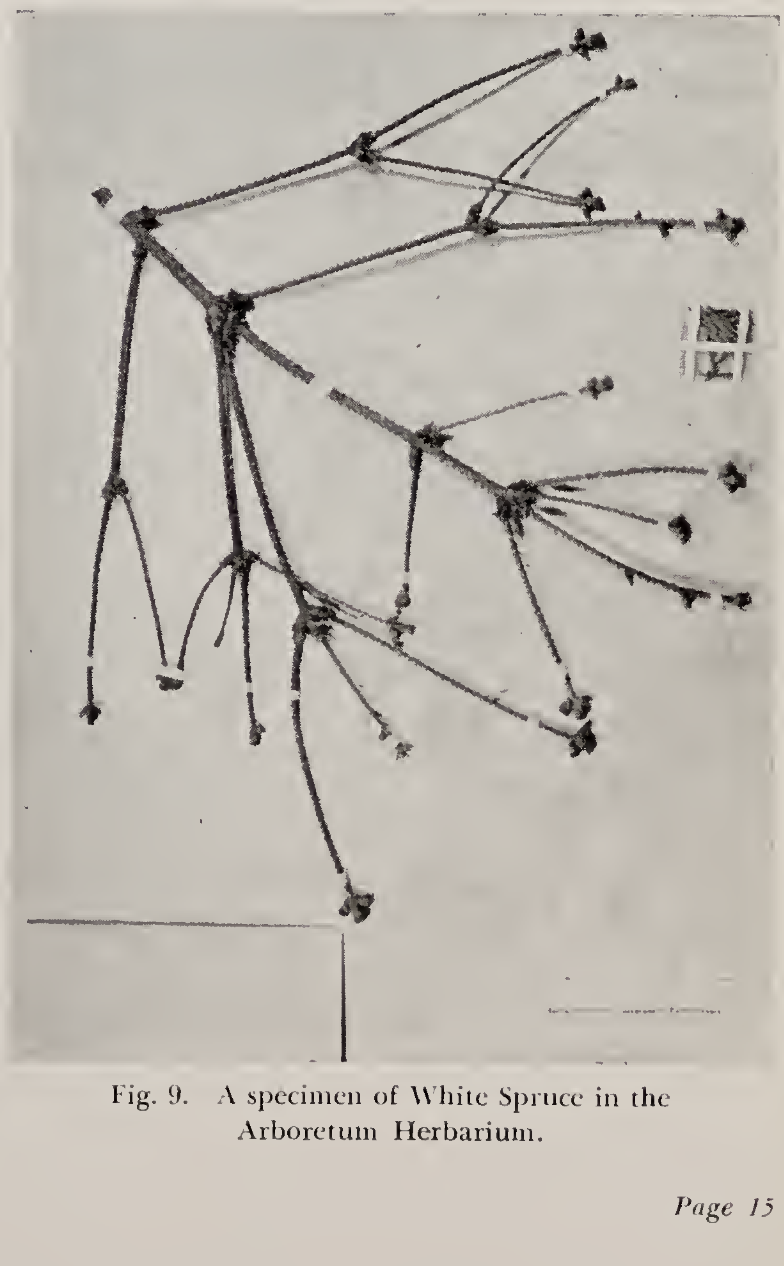


Fig. 9. A specimen of White Spruce in the Arboretum Herbarium.

included only a little work with hemlock, but this genus was used in our preservation studies because of its similarity to spruce in needle retention.

Methods and Results

Natural or artificial glues or other cementing agents could be used to bond the needles to the stems in a crude, mechanical fashion. Dr. Jonathan W. Wright (personal communication) used a gluing technique and maintained intact specimens for eight years. But these methods, while effective to some extent, detract from the naturalness of the specimen and render its use difficult for further anatomical or morphological research.

We have tried to preserve a high degree of naturalness in our specimens. As an example, one of our early, and unsuccessful, experiments involved the use (spraying and absorption) of hormones normally employed to prevent preharvest fruit drop. NAA, 2, 4, 5-T, and an experimental material from Amchem Products Inc., Ambler, Pa., were tested at 20, 50, 100, and 500 ppm. with no success.

A highly effective technique for maintaining intact specimens is the use of glycerine, as prescribed by Lonert.[2] Lonert, however, was not concerned with our particular problem. He was mainly interested in the preservation of plant material in a dry and flexible condition that would be suitable for ornamental arrangements. His test material, which we also used, was Turtox Dry-Flex Concentrate.[3] This product is commercial glycerine to which a non-toxic fungicide has been added to prevent the unsightly molding of the solution. Ordinary gylcerine can be used in any of the formulations below, with no differences except the risk of mold growth.

Lonert outlined three general methods: (1) Absorption; (2) Impregnation; and (3) Copper Salt Impregnation. All three systems were tested, but nos. 1 and 3 were not satisfactory. The absorption technique consisted of placing the basal ends of cut branches in a Concentrate — water (1:2) solution to allow absorption of the glycerine. Absorption generally resulted in poorer color and needle retention. The use of copper chloride and lactic acid in the solution was recommended for the preservation of the natural color in treated specimens. The addition of these chemicals may impart some artificial color but the results do not justify the added inconvenience.

[2] Lonert, A. C. Turtox dry-flex concentrate — for the dry-flexible preservation of gross botanical specimens. Turtox News *40* (2): 58-59. 1962.

[3] Mention of commercial products is not to be construed as endorsement of them by the Forest Service or Department of Agriculture.

Fig. 10. One-year-old treated specimens. Left to right: Top, Oriental and Norway Spruce. Center, White Spruce. Bottom, Black Spruce and Eastern Hemlock.

The impregnation method proved best for our purposes. The solution for this procedure was made up of equal parts of Concentrate and tap water. A tall, wide-mouthed, glass container was filled with the solution and the specimens were submerged in it. It is best to provide an air-tight cover for such containers. The specimens were allowed to remain in the solution for three weeks. After removal from the solution, the branches were rinsed in running tap water and allowed to dry at room temperature for several hours. They were then placed in a standard herbarium press and dried, without added heat, for two weeks. After this period, the specimens were ready for mounting and/or storage. The solution may be used more than once but, owing to the dilution of the glycerine, a longer treatment should be used.

For our tests we used branches of *Picea Abies* (L.) Karst. (Norway spruce), *P. glauca* (Moench) Voss (white spruce), *P. mariana* (Mill.) B.S.P. (black spruce), *P. orientalis* (L.) Link. (oriental spruce), and *Tsuga canadensis* (L.) Carr. (eastern hemlock). Samples were taken in mid-March, before the growing season, and in mid-September, after stem elongation had ceased.

Natural needle retention in the controls was greater in the September collection. All needles in the April collection dropped in two weeks while the Norway spruce taken in September kept their needles for three weeks. However, there were differences in retention of up to a week between branches from the same tree. In the treated specimens, needle retention was slightly better in the April collection.

No needles dropped from the treated branches during the first month after being removed from the press. At this time, and at approximately monthly intervals thereafter, the specimens were stroked gently, in the direction of needle growth, to remove any needles that were not well attached. Some needles were lost during the first few months but, after twelve months, total retention was well over 90 percent (Fig. 10). In comparison, needle retention in the absorption method varied from almost complete retention in hemlock, through about 30 percent with Norway spruce, to complete loss in white spruce.

The color of the needles of the spruces has faded considerably but this is fairly typical of most conifers in herbaria. Hemlock foliage color varies from pale green to light brown, both between branches and on the same branch. While the color retention is not as good as could be desired, it is a marked improvement over the stark, dead-brown color imparted by the absorption method or caused by failure to rinse the impregnated specimens thoroughly. It is also preferable to the artificial mottled or blackened appearance of branches impregnated with copper salts.

The question of whether the treated specimens should be rinsed has not been answered satisfactority. Rinsing definitely leaves more natural color in the needles. It appears that better retention is gained if no rinsing is done, but the specimens are quite brown and they require an extended drying period before mounting.

If the impregnation technique outlined above is followed, one can expect to produce usable and reasonably attractive herbarium specimens. Where time is not a limiting factor, increased needle retention may possibly be gained by extending the treatment period. Limited tests do show, however, that certain needles, perhaps with imperfect connection to the main body, will fall under almost any conditions.

Arboretum Activities

(Continued from Page 2)

Magnolia Society

There is in the process of formation an organization to be known as the Magnolia Society of America. Membership in this society is open to anyone who is interested in this fascinating group of American and Asiatic plants.

The Society plans to issue a Newsletter which will serve as a clearing house for information on such subjects as hardiness, blooming performance, cultural practices, evaluation of new cultivars, requests for the availability of rare or unusual forms, finding lists, and so on.

In order to defray the cost of printing, mailing, etc., the annual dues have been set at $2.00. Anyone desiring to join should send a check in this amount to the Treasurer, Mr. D. Todd Gresham, 103 Frederick St., Santa Cruz, California.

Gift to the Library

The Arboretum Library is the recipient of a notable series of books and pamphlets on bees and bee-keeping. This collection, which numbers about one hundred items, is the gift of Mrs. John O. Enders of Hartford, Connecticut, who presented it to the Morris Arboretum in memory of her late husband.

According to Mr. Fred W. Schwoebel, Curator of the Arboretum's Langstroth Bee Garden, this collection contains many rare and interesting volumes.

Plant Ecology Course

In the Spring of 1962 Dr. Edgar T. Wherry offered at the Arboretum a series of lectures in Plant Ecology. Because of the limitations of space many persons who desired to enroll in this course had to be denied admission.

In response, therefore, to numerous requests, Dr. Wherry has agreed to repeat this course during the current Spring. There will be four lectures followed by a field-trip to the New Jersey Pine Barrens. The dates which have been selected for the lectures are Thursdays, April 4, 11, 18 and 25 at 11 A.M. The date of the field-trip will be decided later.

The subscription fee for this course will be $12.00 and the class will be limited to 20 students on a "first-apply-first-admitted" basis. Those interested please write to the Morris Arboretum or call CHestnut Hill 7-5232.

J. M. F., Jr.

Associates' Corner

Beneath the Surface

Bird-watchers gaze at the tree-tops, horticulturists and botanists at the plants and shrubbery, nature-lovers at the general surroundings — who ever thinks of looking underground?

The next time you stroll through the Arboretum wear soft mocassins and bring your Geiger counter. Here's the reason why: the bugs and grubs, not to mention the nematodes, dwell in a unique world in this particular Arboretum.

Down in this subterranean habitat from a depth of a few inches to several feet, there exists a net-work of drains, pipes, cables, wires, tiles and markers which, if suddenly uncovered, would convert the Arboretum into a first-class obstacle race.

First there are the drains, thousands of feet of them, to carry off the surplus water and prevent the Arboretum from being washed out to sea. From the high ground along Hillcrest Avenue, for example, a battery of 7- and 8-inch terra cotta drain-pipes conduct their watery load into the Swan Pond; farther west still others empty into the stream that flows into the Wissahickon. In the meadow, at the foot of the north slope, is an area of about fifteen acres which is underlain by a maze of agricultural drain and 10-inch pipe. A similar reticulum exists under the Recreation Area.

A few years ago the city installed a 24-inch sewer line across the Arboretum from the Hillcrest Avenue entrance to the area occupied by the native azaleas. For most of its length it follows the lower roadway. Many of us recall the holocaust which attended its construction, but in a few years, in the life of an arboretum, it will be but another example of the old adage, "Out of sight, out of mind."

At one time the water that served the fountains came from a 50,000 gallon tank located just beneath the Seven Arches. The pipes which emanated from this reservoir are now largely abandoned, but they are still down there, rotting away to their heart's content.

And speaking of water, nearly every corner of the Arboretum needs it, especially in periods of drought or at transplanting time. Several miles of pipe serve this vital need. Over a hundred spigots, for attaching hoses or sprinklers, are scattered around the grounds; 50 valves and 28 drainage caps are concealed underground at strategic points. Since these pipe-lines lie close to the surface, and are therefore subject to freezing, they must all be drained in the autumn and put back in operation in the spring. It requires a master-plan just to know where all these are located.

In 1958 the Springfield Township installed a major water main which traverses the Arboretum property from its northernmost boundary diagonally across to Stenton Avenue. Far below the surface provision was made for a metered take-off to supply water to the Quercetum area which was hitherto dependent upon rainfall.

Miss Morris never liked to see overhead wires, so the telephone cables leading to the mansion and the garage are well hidden underground. A subterranean high-voltage electric line enters the Arboretum near the corner of Germantown and Hillcrest, plunges down hill to a transformer (marked at the surface only by a manhole) near the "Wet Steps", passes under a creek, sprouts another transformer, bifurcates, and burrows along to serve its various end-points.

Several years ago the Arboretum was laid out in a system of grids or squares, 200 feet on a side. There are 213 such rectangles and each one has a concrete marker or monument at all four corners. These markers are in the form of cylinders six inches in diameter bearing the identification number of the grid. They are buried thirty inches in the ground and the top comes just below the level of the ground in order to avoid the blades of the mowers. Collectively they constitute an impressive volume of man-made sub-surface material.

All of which merely goes to show that there is a great deal more to an aboretum than meets the eye.

Marion W. Rivinus

Laura L. Barnes Lectureship

In 1940 Mrs. Albert C. Barnes, Director of the Arboretum of the Barnes Foundation in Merion, Pa., established a school of Botany, Horticulture and Landscape Architecture. Classes were conducted in a house directly opposite the Arboretum grounds and the courses were given, by the Director herself, aided by a professional landscape architect and faculty members of the departments of botany from nearby institutions, such as the University of Pennsylvania, LaSalle College and West Chester State Teacher's College. Instruction in the classroom was supplemented by almost daily use of the rich collections of the Arboretum and occasional field-trips to places of botanical or horticultural interest.

In line with the policy of the Foundation, no previous technical knowledge or training has been necessary for admission nor has tuition been charged. The only requisite has been a genuine interest as manifested by regular and prompt attendance at the classes.

Since 1940 more than 600 students have attended the classes and profited from the educational opportunity which they have provided. Desiring to show their appreciation of the rich experience which Mrs. Barnes (now Dr. Laura L. Barnes) has made possible for them, this grateful body of alumni and alumnae has recently raised a substantial sum of money to establish a fund in her honor. This will be known as the Laura L. Barnes Horticultural Lecture Fund.

In accordance with the wishes of the donors, the income from this Fund will be devoted to the giving of lectures at the discretion of the Director of the Morris Arboretum. These lectures are to deal with horticulture, landscape architecture, and appropriate phases of botany, such as taxonomy, ecology, exploration or plant geography.

The first Laura L. Barnes Lecture will be given at the Springside Upper School Auditorium, Cherokee St. and Willow Grove Avenue, Chestnut Hill at 8 P.M. on Tuesday, April 16. The lecturer will be the distinguished English botanist and horticulturist, Dr. John L. S. Gilmour, Director of the Botanical Garden of Cambridge University. Dr. Gilmour will present an illustrated lecture on "The Cambridge Botanical Garden." Associates and their friends are welcome.

J. M. F., Jr.

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Morris Arboretum Bulletin

LEGES SINE MORIBUS VANAE

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Magnolia grandiflora 'Celestial'

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The ASSOCIATES of
THE MORRIS ARBORETUM

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

THE STAFF

On April 6 the Director was the principal speaker at the occasion of the dedication of the new Administration Building of the Norfolk Botanical Garden at Norfolk, Virginia, and on April 25 he gave an illustrated lecture on "Scandinavia and the Low Countries" before the Philadelphia Botanical Club.

Dr. Li gave a seminar talk on "The Flora of Formosa" on May 13 to the Botany Department of the Smithsonian Institution. On May 28 he lectured on "Chinese Flower Painting" at the Philadelphia Museum of Art.

On April 1 Dr. Allison spoke on "The Furtive Fungi" at the regular monthly meeting of the Germantown Horticultural Society. She also gave lectures for the following organizations: Delaware Valley Chapter of the International Shade Tree Conference (April 9), the Family Garden Club (April 11) and the Delaware Valley Men's Garden Club (May 15).

Mr. Dourley represented the Arboretum at the annual meeting of the Association of Kew Gardeners in America held in New York on March 11.

(*Continued on Page 37*)

Two American Incomparables: Magnolia Macrophylla and M. Grandiflora

D. Todd Gresham

To this day the brightness of a small boy's first meeting with the Bigleaf Magnolia (*Magnolia macrophylla*) remains undimmed. My parents were invited to a dinner, and I was permitted to accompany them. The host was noted as a collector of rare trees, and the ground surrounding his colonial home were planted with woody plant material from around the world.

Cautioned to "mind my manners", the sight of the dinner table was my undoing, to my parents'

Fig. 11. M. macrophylla 'Holy Grail'

embarrassment. Never had I seen such an unusual table setting, or one so demanding of a small boy's close inspection.

The long shining mahogany table, was lighted by three massive silver candlelabra; encircling the base of each holder were four perfect blossoms of *Magnolia macrophylla,* their washed and oiled great leaves radiating from the base, and serving the unusual purpose of place mats for the service and glassware. Dinner completed, I asked our host to be permitted to take all the flowers home with me.

Fig. 12. M. macrophylla 'Holy Grail'

Along a woodland stream in Alabama; a busy highway on Long Island; an old residential street in Petersburg, Virginia; regardless of season, I have never been in too great a hurry to stop and admire *Magnolia macrophylla* one of the two American Incomparables.

In 1956, while browsing through a California nursery, I discovered a thrifty *Magnolia macrophylla* in a five gallon can. Planted out on Mon-

Fig. 13. M. macrophylla 'Holy Grail'

Fig. 14. M. macrophylla 'Holy Grail'

terey Bay, within the sheltering arms of ancient trees of *Quercus agrifolia,* the young plant never looked back, and has made good growth, with only an occasional broken branch by playful baby coons.

On the 3rd of July 1962, this wonderful plant, so far from its native haunts, rewarded my care with its first flowers. Then three green sepals began to relax, exposing the white whiteness of the blossoms. This, as it enlarges, is a marvelous upstanding vase, the tips of the three outer tepals reflexing gracefully to expose the electric blue-violet basal zones of the three inner tepals.

Stigmas and gynoecium at this stage are white, but as flower ages, the stigmas become jet black, in contrast to the white gynoecium. Flowers opening in afternoon shade lasted well, five to six days in good condition.

Fig. 15 M. macrophylla 'Holy Grail'

To assist in visualizing the exotic, tropical appearance of this superb flowering tree: the great flower nests in the hub of a wheel of radiating foliage 30 inches (75 cm.) long, their under surface of silvery whiteness. The green sepals, holding the white tepals, are 7 inches (17.5 cm.) long. The largest of outer tepals 8½ inches (22.5 cm.) long by 5 inches (12.5 cm.) broad, inner tepals 8 inches (20 cm.) long by 4 inches (10 cm.), flower 17 inches (42.5 cm.) in diameter, maintaining the high chalice form until the tepals shed.

Fig. 16 M. grandiflora 'Celestial'

After many hours observing the beauty of this flower, in the halfshade of the oaks, I could think of no appelation more appropriate than the 'Holy Grail'. (Figs. 11 to 15) This name has now been officially registered with the Morris Arboretum.

The other member of this duo of American Incomparables, is *Magnolia grandiflora,* the Bull Bay of our southern states.

It does not seem possible that a species of ancient origin could be so variable from seed. To walk a row of *Magnolia grandiflora* seedlings,

Fig. 17 M. grandiflora 'Celestial'

Fig. 18 M. grandiflora 'Celestial'

and note the extreme variability of leaf, and habit of growth, would lead one to assume they were hybrids, the progeny of two completely unlike parent plants.

Foliage may be narrowly lanceolate; a wide and long elliptic leaf ending in a sharply acuminate tip or broadly obovate, with rounded apex; or the under surface thickly matted with an attractive brown indumentum, or to the eye, glabrous. Leaf coloring may vary from an inherent deep lustrous green, to a not too pleasant yellow green, with a matte finish. The branching habit is wide-spreading, covering a considerable area, or closely columnar, almost fastigiate.

Flowering behavior, also, is extremely variable. One tree will set buds at an early age, and blossom profusely over a long period; another may require years to flower, and be notably stingy with its blossoms. Flowers may be small and ill-formed, others large and of noble formation and texture. Even the pervasive perfume is produced in differing strengths.

Undoubtedly *Magnolia grandiflora* is also variable as to hardiness range, these acclimated individuals being much hardier than commonly rated. It is possible, when selected for this factor, its zoning will be extended to delight a broader segment of growers.

The statements concerning this variation can lead only to one conclusion: *Magnolia grandiflora* should, if possible, be grown from asexually produced stock, selected for outstanding, constant and proven excellency of character.

Magnolia grandiflora 'Celestial', (Figs. 16 to 18) may be described as a tree of wide-spreading character, blooming profusely over a long period, with very large, well formed flowers to 15 inches (37.5 cm.), carried in full view. The leaves are large, lustrous, with moderate indumentum. This name, also, has been registered at the Morris Arboretum.

For me, *Magnolia grandiflora,* thickly sprinkled with sweet scented blossoms, against shining dark green foliage, is a soft black night, lit by all the celestial bodies, and is as close to Heaven as I can safely aspire.

Winter Damage 1962-1963

The effects of the recent winter have been so devastating both in this country and abroad that we have thought our readers would be interested in reading a trio of statements from a wide variety of geographic localities, proceeding from East to West.

In addition to our own observations (which have already appeared in the Summer Issue of the Arboretum Bulletin of the University of Washington Arboretum at Seattle) we are pleased to present reports from the following: Mr. E. L. Kammerer, Curator of the Morton Arboretum, Lislie, Illinois and Mr. J. A. Witt, Assistant Director of the University of Washington Arboretum, Seattle, Washington.

The Morris Arboretum

John M. Fogg, Jr.

The winter of 1962-63 must go into the annals as one of the most severe in the history of the Philadelphia area. Although we made a similar pronouncement in the spring of 1961 and again last spring, the severity of the recent winter exceeded that of its two predecessors. This was due largely to three factors: persistent low temperatures, high wind velocities, and lack of precipitation.

November was the coldest since 1901 and the winds were the highest since 1959. There was a slight excess of precipitation, but no snow-fall.

December was marked by abnormally low temperatures, high winds, and very scanty precipitation, only nine inches of it in the form of snow.

January witnessed deficiencies in precipitation (about an inch) and temperature (nearly five degrees). Again, there was very little snow (about six inches).

February was likewise deficient in rainfall and temperature units (nearly seven degrees) with extremely high winds and very light snow-cover.

March was what might be called a "normal month", until its closing days when record-breaking high-temperatures occurred over a four-day period. Again, very little rainfall.

Probably the most significant of all of these factors has been the lack of precipitation with the resulting absence of any continuous snow-cover. The total snow-fall for the winter has been only 20.5 inches, compared to 28.8 in 1961-62 and 49.1 in 1960-61. In short, we are in the vise-like grip of a drought which dates back to August, 1961. From January 1 to April 30, 1963, this area has been over four inches deficient in precipitation.

The joint effects of low rainfall and lack of appreciable snow-cover are reflected in the damage sustained by the woody plants in the Arboretum. While it is still too soon fully to assess the extent of this injury, it seems desirable to record a few of its obvious effects before they become obscured by other factors.

Conifers

Most of the members of the Pine Family survived the winter far more satisfactorily than was the case in the two preceding seasons. It is true that we lost about a score of recently outplanted eastern white pines (*Pinus Strobus*) and that our more temperamental plants, such as *Cryptomeria japonica* and *Cunninghamia lanceolata,* experienced even more "winter burn" than usually occurs. But when such marginal species as *Pinus palustris* and *Cedrus deodara* come through apparently unscathed, one is tempted to conclude that most representatives of the Pinaceae are better adapted to survive under conditions of low rainfall than are many of the Angiosperms.

The same, however, can not be said of the taxads. We have lost numerous specimens of Irish Yew (*Taxus baccata*) and Japanese Yew (*T. cuspidata*) and even some of our Plum Yews (*Cephalotaxus* spp.) appear to be in very precarious condition.

Broad-leaved Evergreens

It was among the members of this group that our most severe damage occurred. Many have been killed completely; others are badly damaged but may eventually make new growth. In all cases patience must be exercised in hopes that some regeneration may take place.

Certain species, such as *Cleyera japonica, Arbutus Unedo* and *Symplocos tinctoria,* are admittedly tender in the Philadelphia area and their demise was not surprising. Others, such as the evergreen barberries, e.g. *Berberis Julianae* and *B. verruculosa,* have survived most winters in fairly good condition, but this year were severely damaged. Another group which suffered badly were the evergreen cherries *Prunus caroliniana, P. Laurocerasus* and *P. lusitanica.* The same is true of the evergreen privets (*Ligustrum lucidum* and *L. japonicum*), as well as *Lonicera nitida* and *L. pileata.*

Aucuba japonica and *Mahonia Bealii* were among the other broad-leaved evergreens seriously affected, and throughout the entire area there appears to have been wholesale destruction of the valuable ground-cover, *Sarcococca Hookeriana.*

Other evergreen forms which have been seriously injured if not killed outright are *Stranvaesia Davidiana, Pyracantha coccinea, Photinia serrulata, Elaeagnus pungens* and *Daphne odora.*

The hollies have suffered less than many other groups, but a few plants of *Ilex Aquifolium* have lost most of their leaves and are slow to make new growth.

Deciduous Plants

Although less seriously affected than the broad-leaved evergreen, many groups of deciduous plants succumbed during the recent winter.

Our greatest loss was among the roses and this is the case not only at the Arboretum but applies widely throughout the area. One large rose nursery is able to fill only a small fraction of its orders and others report that their losses will run into many thousands of dollars.

Another group in which wholesale havoc was wreaked was the Azaleas. This was particularly true of native species which might be expected to be somewhat more hardy. We have suffered severe loss in such species as *Rhododendron arboreum, R. calendulaceum, R. canescens* and *R. serrulatum.* Strangely enough, *R. prunifolium,* a native of Georgia and Alabama, came through apparently unscathed.

Mature specimens of the Jujube (*Zizyphus jujuba*) and the Franklin Tree (*Franklinia alatamaha*) have been killed outright. Others, such as the hardy orange (*Poncirus trifoliata*), crape myrtle (*Lagerstroemia indica*), Chinese fringe-tree (*Loropetalum chinense*) and *Daphne Mezereum* have been so mutilated that their recovery is highly problematical.

Noteworthy Survivals

As is usually the case following any unusual season, certain paradoxes have emerged. A number of plants which are at or near the northern limits of hardiness have managed to survive and seem to be in excellent condition. This includes Alexandrian Laurel (*Danae racemosa*) the anise-tree (*Illicium floridanum*), *Pistacia chinensis, Adina rubella,* and *Koelreuteria formosana.*

One of the most remarkable of all is the survival of two plants of *Elliottia racemosa,* a species from South Carolina and Georgia, which is usually regarded as not being hardy in the Philadelphia area, but which in this instance have seemingly been untouched by the recent severe season.

The Morton Arboretum

E. L. Kammerer

An extended drought beginning in late summer, 1962 and continuing well into the new year,[1] thirty-seven days of sub-zero (F.) temperature, the first of which was recorded on December 11 (4° below) and the last on March 1 (1° below),[2] a hard freeze on May 1 (24°) and a later one on May 23 (29°), — these are the conditions which combined to make the winter and spring of 1962-63 a memorable one from the standpoint of damage to plants. And, with so many factors involved, one can only speculate as to whether one or a combination of several contributed to the injuries resulting.

Judging from the unexpected satisfactory wintering of a number of normally tender plants, it would seem that the drought, in some instances, may have been a blessing in disguise. For, by inducing early dormancy, the new wood went into the winter well hardened and without the softness and high moisture content usually contributing to winterkilling. This was not true of every plant, however, the extent of the injury plainly indicating the inability of many genera to tolerate prolonged periods of intense cold and abnormally deep frost penetration. As a matter of record, the frost in some places in the Arboretum was found to extend almost 4 feet into the ground.

[1] Precipitation deficiency for 1962, 10 inches (mean annual total 34 inches).

[2] Minimum temperature of the winter — 26° below zero (F.) recorded on January 28, 1963; on nineteen occasions temperatures of — 10° below zero (F.) or lower were recorded, on six — 20° below zero (F.) or lower.

Obviously a survey in an area as large as the Arboretum cannot be all inclusive, but the following notes will serve as a record of the comparative damage already evident among the woody plants in the collection. What additional effects will show up later cannot be predicted.

Trees

Acer Davidi, David Maple — killed to ground (Frost Hill).

Acer Lobelii, Lobel Maple — severe winter injury (Frost Hill).

Acer palmatum atropurpureum, Bloodleaf Japanese Maple — winter die-back evident on a number of plants.

Albizia julibrissin rosea, Hardy Silktree — killed back to ground as usual.

Castanea dentata, American Chestnut — slow in leafing, foliage sparse.

Castanea mollissima, Chinese Chestnut — leafing retarded.

Catalpa ovata, Chinese Catalpa — leafing abnormally slow.

Celtis spp. Hackberry — slow in leafing, possibly a combination of drought, winter injury and frost damage.

Cercis canadensis, Redbud — many plants not leafing normally.

Cercis canadensis 'Withers Pink Charm', Withers Pink Charm Redbud — killed to ground.

Cercis chinensis, Chinese Redbud — all but two plants killed to ground.

Cornus florida, Flowering Dogwood — flowered sparsely, and those specimens which did bloom produced many small, misshapen flowers, for the most part on the lower branches which had been snow covered.

Cornus macrophylla, Largeleaf Dogwood — branch die-back evident on plant near Arboretum center terrace.

Eucommia ulmoides, Hardy Rubber Tree — tree in Arboretum Center grounds badly injured, larger specimens on Frost Hill fared better.

Evodia Daniellii, Korean Evodia—severely killed back.

Evodia hupehensis, Hupeh Evodia — all growth killed back to main branches.

Fraxinus excelsior, European Ash — extensive winter injury noted, even among established trees; some branches killed completely.

Fraxinus excelsior pendula, Weeping European Ash — leafed late, foliage very sparse.

Fraxinus holotricha 'Moraine', Moraine Ash — killed to ground in street tree collection.

Ginkgo biloba, Ginkgo, Maidenhair Tree — leafing retarded and spotty; some trees very slow in coming out; frost damage and possible winter injury suspected.

Gleditsia aquatica, Waterlocust — severe damage even on an eight inch tree.

Gleditsia triacanthos and cultivars, Honey Locust — late in leafing, probably as a result of drought and frost damage.

Gymnocladus dioicus, Kentucky Coffee Tree — leafing retarded, very likely as a result of frost.

Halesia carolina, Silverbell — flowers small and not as abundant as usual; some growth killed back; a combination of drought and winter injury suspected.

Laburnum anagyroides, Goldenchain Laburnum — severely killed back.

Laburnum Watereri, Waterer Laburnum — killed to ground.

Liquidambar Styraciflua, Sweet Gum — winter injury evident on small specimens.

Magnolia denudata, Yulan Magnolia — flower buds injured, failed to open.

Magnolia virginiana, Sweet Bay Magnolia — not leafing normally; both frost damage and winter injury suspected.

Magnolia salicifolia, Anise Magnolia — flowered very sparsely.

Metasequoia glyptostroboides, Dawn Redwood — some dead wood evident on one plant.

Morus australis, Japanese Mulberry — frost injury evident.

Paulownia tomentosa, Empress Tree — tree in Arboretum Center grounds killed to ground (not unusual); two-thirds of the tops of older specimens were killed back.

Phellodendron spp., Cork Tree — all species slow in leafing.

Platanus occidentalis, Sycamore — slow in leafing, frost damage suspected.

Prunus Sargenti, Sargent Cherry — most flower buds blasted.

Pterocarya stenoptera, Chinese Wingnut — some winterkilling of tip growth.

Quercus Cerris, European Turkey Oak — much injury in top of tree, also frost damage.

Quercus petraea Giesleri, Durmast Oak variety — both twig die-back and frost damage evident.

Quercus robur, English Oak — some winterkill evident (Edgewood Drive).

Quercus serrata, Sawtooth Oak — severe kill-back on established trees.

Sassafras albidum, Common Sassafras — leafing retarded.

Zelkova sinica, Chinese Zelkova — the usual severe die-back.

Shrubs

Buddleia Davidi cultivars, Orange-eye Butterfly Bush — most plants killed outright.

Calycanthus floridus, Sweetshrub — top growth winterkilled.

Chaenomeles lagenaria cultivars, Japanese Quince — die-back evident on some plants.

Clethra alnifolia, Summersweet Clethra — several well established plants 8 feet tall severely injured.

Comptonia peregrina, Sweetfern — some tip injury noted.

Cornus kousa chinensis, Chinese Kousa Dogwood — severe winter injury on most plants; one specimen in Ericaceae group set flower buds, but these were blasted by the cold.

Cornus paucinervis, Littleleaf Dogwood — severely injured.

Cotinus americanus, American Smoke Tree — die-back evident on many plants.

Cotinus Coggygria, Smoke Tree — considerable winterkill evident.

Cotinus Coggygria 'Notcutts Purple,' Notcutts Purple Smoke Tree — most top growth killed back.

Cotinus Coggygria purpurea, Purple Smoke Tree — severe kill-back.

Cotinus Coggygria 'Royal Purple', Royal Purple Smoke Tree — severe kill-back.

Cotinus Coggygria rubrifolius, Redleaved Smoke Tree — top growth severely injured.

Cotoneaster divaricata, Spreading Cotoneaster — killed back severely.

Cotoneaster horizontalis 'Tures selection' — killed to ground.

Cudrania tricuspidata, Silkworm Thorn — tip growth injured.

Daphne caucasica, Caucasian Daphne — some branches winterkilled; blossomed well, however.

Diervilla in variety, Bush-Honeysuckle — severe die-back throughout the collection.

Fontanesia Fortunei, Fortune Fontanesia — die-back evident on all plants.

Franklinia alatamaha, Franklinia — killed to ground.

Genista tinctoria, Common Woadwaxen — severe die-back though the plants are blossoming well on the new wood.

Hamamelis mollis, Chinese Witchhazel — killed to ground.

Hibiscus syriacus cultivars, Althea — more than the usual winter damage.

Hydrangea quercifolia, Oakleaf Hydrangea — top growth severely injured, only a few upright branches alive.

Hypericum Hookerianum 'Hidcote', Hidcote St. Johnwort — killed outright.

Hypericum 'Sungold', Sungold St. Johnswort — killed outright.

Ilex serrata, Finetooth Holly — one plant severely injured.

Itea virginica, Virginia Sweetspire — tip growth severely injured.

Kerria japonica, Japanese Kerria — more severe die-back than usual.

Ligustrum Quihoui, Quihou Privet — killed to ground.

Lindera Benzoin, Spicebush — severe injury, some plants killed to the ground.

Lonicera fragrantissima, Winter Honeysuckle — most branches killed to the ground.

Myrica cerifera, Southern Waxmyrtle — killed to ground.

Neillia sinensis, Chinese Neillia — damage to tip growth extensive.

Prunus glandulosa, Flowering Almond — severely killed back.

Prunus glandulosa alboplena, White Flowering Almond — severely killed back.

Prunus pumila, Sand Cherry — severe winterkill evident (in lighter soil the damage might have been negligible) .

Pyracantha coccinea Lalandi, Laland Firethorn — severe winterkill occurred on most plants.

Rhododendron luteum, Pontic Azalea — flower buds blasted.

Rhododendron reticulatum, Rose Azalea — killed to the ground.

Rhododendron Schlippenbachi, Royal Azalea — flower buds blasted, foliage frosted.

Rhododendron viscosum, Swamp Azalea — flower buds blasted.

Rhus aromatica, Fragrant Sumac — leafing abnormally.

Rosa spp., Rose — severe winterkilling throughout the species collection.

Rubus odoratus, Purple Flowering Raspberry — some injury to tip growth.

Rubus parviflorus, Western Thimbleberry — severe kill-back.

Sambucus in variety, Elder — more than the usual winterkill.

Securinega suffruticosa — killed back to main branches.

Spiraea brachybotrys — killed to ground.

Syringa vulgaris in variety — a very poor display, flower buds showing both winter and frost injury.

Tamarix gallica, French Tamarisk — severe tip injury.

Tamarix tetrandra, Fourstamen Tamarisk — tip growth damaged.

Viburnum dilatatum, Linden Viburnum — tip growth winterkilled.

Viburnum dilatatum xanthocarpum, Yellowberry Linden Viburnum — severely killed back.

Viburnum fragrans album, White Fragrant Viburnum — flower buds partially blasted.

Viburnum plicatum, Doublefile Viburnum — severely damaged, some plants killed to ground.

Viburnum plicatum Mariesi, Maries Doublefile Viburnum — killed to ground.

Viburnum plicatum tomentosum, Japanese Snowball — severly damaged, some plants killed to ground.

Viburnum rhytidophylloides, Lantanaphyllum Viburnum — top growth and some main branches injured.

Viburnum rufidulum, Southern Blackhaw Viburnum — severely killed back.

Viburnum Sargenti flavum, Yellowfruit Sargent Cranberrybush Viburnum — much damage to top growth.

Vitex Negundo incisa, Cutleaf Chastetree — die-back more severe than usual.

Weigela in variety, Weigela — more than usual die-back.

Evergreens (Coniferous)

Cedrus atlantica glauca, Blue Atlas Cedar — killed outright.

Chamaecyparis spp. and varieties, Falsecypress — show various degrees of burning.

Juniperus chinensis pendula, Weeping Chinese Juniper — killed outright (Juniper collection).

Juniperus communis cracovia, Polish Juniper — burning evident on south side of plants.

Juniperus communis suecica, Swedish Juniper — foliage burned on south sides of plants (Frost Hill).

Pinus Thunbergii, Japanese Black Pine — foliage burn unusually severe.

Taxus cuspidata, Japanese Yew — browning of tip growth evident in some locations; serious browning reported elsewhere in the Chicago area.

Evergreens (Broadleaf)

Euonymus Fortunei Carrierei, Glossy Wintercreeper Euonymus — top growth injured.

Ilex crenata Hetzi, Hetz Japanese Holly — killed to ground (Frost Hill).

Ilex glabra, Inkberry — injury severe.

Ilex opaca, American Holly — severe foliage burn and some twig injury in most locations.

Leucothoe Catesbaei, Drooping Leucothoe — foliage shows considerable winter-burn.

Mahoberberis Neuberti — completely defoliated, but recovered completely.

Mahonia Aquifolium, Oregongrape Mahonia — foliage severely burned.

Mahonia repens, Creeping Mahonia — foliage burned.

Rhododendron catawbiense, Catawba Rhododendron — some foliage burn evident on plants exposed to winter sun.

Rhododendron Fortunei, Fortune's Rhododendron — flower buds blasted, some twig injury.

Rhododendron hirsutum, Garland Rhododendron — some winter damage evident.

Rhododendron micranthum repens, Dwarf Manchurian Rhododendron — killed to ground.

Hedges

Acer Buergerianum, Trident Maple — killed to ground.

Acer campestre, Hedge Maple — severe winterkill necessitated cutting hedge back to the ground line.

Berberis mentorensis, Mentor Barberry — killed to ground.

Carpinus japonica, Japanese Hornbeam — killed to ground.

Celtis pumila, Small Hackberry — killed to ground.

Cotoneaster nitens, Pinkblush Cotoneaster — killed to ground.

Ilex opaca, American Holly (old hedge) — foliage burned, but little tip growth injury.

Ilex opaca 'Bosley Hedge Holly', Bosley Hedge Holly — severely damaged (foliage burn, die-back) in spite of a protective cover.

Ilex verticillata, Winterberry — much dead wood throughout the hedge.

Kolkwitzia amabilis, Beautybush — much dead wood evident.

Ligustrum ibolium, Ibolium Privet — killed to the ground.

Ligustrum obtusifolium, Regel's Border Privet — killed to the ground.

Maclura pomifera, Osage Orange — shows considerably more winterkilling than normally.

Morus alba 'Dwarf', Dwarf White Mulberry — killed to the ground.

Rosa multiflora, Japanese Rose — killed to the ground.

Taxus cuspidata densa, Cushion Japanese Yew — severely burned.

Taxus cuspidata nana pyramidalis, Pyramidal Dwarf Japanese Yew — some winter burn evident.

Taxus media Browni, Browns Anglojap Yew — tip growth burned.

Taxus media Hatfieldi, Hatfield Anglojap Yew — severely burned.

Vines

Hedera Helix and cultivars, English Ivy — severe die-back on climbing specimens throughout the area.

Plants which surprised us by blossoming well in spite of climatic extremes

Abeliophyllum distichum, Korean Abelia-leaf — has never bloomed more profusely.

Buddleia alternifolia, Fountain Buddleia — blossoming normally.

Cercis canadensis, Redbud — flowered normally though its leafing was erratic.

Daphne caucasica, Caucasian Daphne — good bloom.

Forsythia, Goldenbells — unusually good bloom.

Genista tinctoria, Dyer's Greenweed — blooming normally.

Hamamelis mollis brevipetala, Chinese Witch-hazel variety — alive to the tips and blossomed well; foliage sparse however.

Magnolia tripetala, Umbrella Magnolia — wintered satisfactorily and blossomed normally.

The University of Washington Arboretum

J. A. Witt

In order to understand the effects of weather on the vegetation of any given area it is necessary to know a little about its climate. Seattle is located about ninety miles east of the Pacific Ocean and is some 525 miles further north than Philadelphia, at approximately the same latitude as the mouth of the St. Lawrence river. It is shielded in part from north Pacific storms by the Olympic mountains to the west, and, despite rumors to the contrary, receives only 32 inches of precipitation in a normal year. The rain is concentrated in the winter months and there is usually a period of drought in the summer. The average rainfall for December is 5.34 inches, for July, 0.52 inches. The temperatures are mild with an average minimum for the coldest month, January, of 36.2° F., and an average maximum of 75.2° F. in July.

The winter of 1962-63 was marked by several unusual aspects. The fall was mild and wet, with no frost until late November when a minimum temperature of 32° F. was recorded on the 23rd and no more frost until two days with 32° F. minima were noted in late December. In January the rains stopped and the thermometer dropped as a mass of arctic air moved down from Canada. For three days the maximum temperatures were below freezing and a minimum of 14° F. was reached, the coldest day on record for several years. There was another cool period late in January with dry N.E. winds and minimum temperatures down to 21° F.

While these temperatures may seem relatively mild to gardeners in the colder sections of the country, they furnished the first really severe test many of our more tender species had for a number of years.

Naturally the broad-leaved evergreens suffered the most; low temperatures, desiccating winds and no snow cover are conditions that none of this group of plants likes. Even so, only the least hardy of our collections were either killed or were badly cut back. These include *Eugenia Chequen, Myrtus Luma, Acacia dealbata, Eucalyptus gigantea* and *Nothofagus Solanderi*. These are all from the southern hemisphere and are usually considered borderline hardy in the Seattle area. Many similar plants were damaged by the 18 degrees of frost but most recovered after suffering some degree of defoliation or loss of young shoots. Again southern hemisphere plants lead the list, but Californian, Himalayan and Mediterranean species were also included.

The evergreen maple, *Acer oblongum,* lost most of its leaves as did several of the California wild lilacs, *Ceanothus* species; the shrubby veronicas, *Hebe* species; the yellow berried yaupon, *Ilex vomitoria* 'Xanthocarpa'; *Nothofagus cliffortioides;* the island bush poppy, *Dendromecon Harfordii;* and several clones of rosemary, *Rosmarinus officinalis.* Some plants we thought might be damaged came through unscathed. Our extensive rhododendron collection has suffered in hard winters in the past but only a few of the large-leaved species such as *R. grande* had even burned leaves, and we had an unusually fine flowering on most plants this spring.

Of very considerable interest was the reaction of plants in flower to the cold. The Portuguese heath, *Erica lusitanica,* was in full bloom and lost hardly a floret; the *Sarcococca* species never looked better even though their delicate white blossoms were frozen solid for nearly three days, and the Chinese witchhazel, *Hamamelis mollis,* thrived on the cold. Other plants flowering during that time seemed impervious as well. The manzanitas, *Arctostaphylos* spp.; *Viburnum fragrans* 'Candidissimum'; winter sweet, *Chimonanthus praecox,* and the evergreen *Ribes laurifolium* all scarcely had a flower browned.

The open flowers on the autumn cherry. *Prunus subhirtella* 'Autumnalis', on *Rhododendron mucronulatum, Iris unguicularis* and some of the *Camellia japonica* clones, however, were blasted to a brown and sticky pulp. Even so, when moderate weather returned in a week or so all these recovered and sent out another set of their cheerful blooms.

Although we who garden in the northwest have had our weather troubles in the past and doubtlessly will again, last winter appears to have been a relatively easy one on our plant material, especially after reading reports on what occurred in eastern and European gardens during the same period.

The Butterflies of the Morris Arboretum

Arthur M. Shapiro

(*Continued from Page 14*)

Limenitis archippus, Viceroy (114)

This is the species which has attracted so much publicity as the mimic of the supposedly inedible Monarch. The Viceroy is rather common at the Arboretum, occurring rarely in section 1 (a) (once) and more frequently all along the Wissahickon from section 3 to 4 by way of 1 (b). The butterflies remain close to the Willows, and fly up and down along the creek banks.

There are three flights, in mid-May to mid-June, July to early August, and early September, the last being only partial. The food plants at the Arboretum are willows, *Salix nigra* and *S. sericea*. Males are quite dark, reddish brown, almost as dark as Virginia specimens, but females are considerably paler.

Limenitis arthemis, Banded Purple (116)

This is a northern species, which does not occur in typical form as far south as Philadelphia. However, there has been an infusion of genes from this species into the local stock of *Limenitis astyanax* as a result of hybridization to the north, from Scranton northward. Actually, then, what we call "hybrids" are actually *astyanax* with a few evident *arthemis* characteristics acquired at second hand. The form *"proserpina"* is like *arthemis* in the red spots but lacks the white band. It has not been found at the Arboretum. The form *"albofasciata"* is like *astyanax* but has the white band diagnostic of *arthemis*. One individual was seen, but not caught, in section 1 (a) on July 28, 1961. The two "hybrid" forms have both been caught elsewhere in the district, in Philadelphia and Montgomery County.

Limenitis astyanax, Red-Spotted Purple (116)

This is another species which is common throughout most of the region, but is seldom encountered at the Arboretum. After a long period of scarcity, it was more common in 1962; only seven were seen at the Arboretum, however. These were in areas 1 (b) and 4. In every case where the insect was seen at the Arboretum, it was flying rather high off the ground, and could not be captured. There are two broods, in late May to early June and mid-July to early August. The larvae have not been found at the Arboretum, but elsewhere are known to feed on Wild Cherry (*Prunus*, various spp.) and willow (*Salix* spp.). This is another case where no factor is apparent which would account for the scarcity of the species.

Asterocampa celtis, Gray Emperor (120)

This is one of the better species which occur at the Arboretum. It is restricted to section 3. One specimen was taken inside the greenhouse on August 21, 1959 (W. F. Boscoe); and three were taken in early July of 1962. The butterfly is brightly colored and distinctively marked. It occurs in close association with the common Hackberry, *Celtis occidentalis*, which is known to be its food plant elsewhere. Apparently there are two broods, although at most other localities in the region where the species occurs, only one has been noted, through June and early July.

Family Lycaenidae

Strymon melinus, Gray Hairstreak (134)

A very common species at the Arboretum and elsewhere, the Gray Hairstreak has been found in areas 1 (a), 1 (b), 2, and 4. Like all the Hairstreaks, it has an exceedingly rapid, erratic flight.

There are three broods, in May, late June to mid-July, and early August to late September. The spring brood is the smallest, and two spring specimens only have been taken at the Arboretum. The food plants at the Arboretum are the various species of *Polygonum*. Elsewhere the species has been found on the Common St. John's Wort, *Hypericum perforatum*, and on the cultivated String Bean, *Phaseolus vulgaris*, and various other garden beans. The insect is strongly a denizen of open spaces.

Chrysophanus titus, Coral Hairstreak (134)

The Coral Hairstreak has a local distribution, but is common enough where it does occur. At the Arboretum is has been taken on Milkweed blossoms in section 1 (b) and on *Apocynum* in area 4.

There is one flight only, from late June through mid-July. The food plant is reputed to be Choke Cherry (*Prunus virginiana*), but the larvae have not been observed at the Arboretum. This species was unusually common in 1962. One specimen taken was considerably undersized (wingspread only 23 mm.) and had the coral-red spots beneath replaced by orange.

Satyrium edwardsii, Edwards' Hairstreak (137)

This is a common species at the Arboretum, but thus far has been only found on Milkweed in section 1 (b). It was unusually numerous in 1961 and scarce in 1962.

As in most of the Hairstreaks, there is only one brood, flying in late June and early July. The freshest specimens of this species, which is very like the next, may best be obtained by collecting a bit earlier than one would for *S. falacer. Edwardsii* usually flies with *titus*. The food plant at the Arboretum has not been determined; elsewhere it is known to feed on Scrub Oak (*Quercus ilicifolia*).

Satyrium falacer, Banded Hairstreak (137)

This species is very like the previous one, but may be told from it by the less strongly offset pattern. It has the same flight period and habits, but has also been taken in area 4 and once in area 3 among foliage (June 29, 1959). A few males have a red spot at the anal angle of the hind wing above. The food plant at the Arboretum is Chestnut Oak (*Quercus Prinus*). This species was also unusually common in 1961, and scarce in 1962; it is usually even more common than *S. edwardsii*, and generally emerges five to eight days later.

Satyrium liparops, Striped Hairstreak (138)

The rare Striped Hairstreak occurs in a very special environment in Area 4. The few specimens that have been taken or seen were sitting in the *Polygonum* stands along the stream on the wooded side of the depression alluded to in the General Discussion, or were on *Apocynum* blossoms nearby. The food plants listed for the species are very varied, but the mostlikely candidate would appear to be a *Vaccinium* which grows in small quantities in the area. As is the case with its relatives, the Striped Hairstreak has only one brood, in early July, and it is quite wary and difficult to catch.

Feniseca tarquinius, Harvester (150)

"Harvester" somehow does not seem an appropriate name for this creature, our only carnivorous butterfly. It occurs sparingly and at irregular intervals in area 4, and was last taken there July 24, 1961. The larva feeds on Woolly Aphids, which infest a variety of plants ranging from Black Alder to Apple to Dead-Nettle (*Boehmeria*). The species is quite scarce throughout southeastern Pennsylvania, and may be considered one of the better Arboretum species. It is subject to rather extensive color and pattern variation. It flies in May and July.

The butterfly does not visit flowers regularly. It may best be obtained by jarring the undergrowth, thus rousing it. Its flight is weak, and it may easily be taken with the net. All of the specimens seen have been within 50 yards of the Wissahickon or its tributary streams.

Lycaena phlaeas, Small Copper (151)

This rather common butterfly has at one time or another turned up everywhere in the Arboretum with the exception of the woods. There are four broods, in mid-May, late June to early July, mid-August, and early September to late October. The butterfly flies very low, just above the ground, and can be mistaken for *Phyciodes tharos* rather easily.

The food plant is Common Sorrel, *Rumex Acetosella*. This butterfly is subject to an interesting seasonal variation; the "cold weather" form is lighter, brassier orange, and the black markings are conspicuously reduced.

Lycaena thoe, Bronze Copper (153)

The Bronze Copper is at the same time the most beautiful and the rarest of the Arboretum butterflies. It has been taken only once in the County, at the Arboretum, in field 1 (b) near the plank bridge that crosses the stream southeast of Northwestern Avenue, in the tall grass. The specimen, a fresh male, was taken August 23, 1962. The species has one other colony known to be in the region, 25 miles away, near Horsham. It is a typical marsh dweller, and is said to feed upon the common Curly Dock, *Rumex crispus,* but only in damp situations. The sexes are strikingly dissimilar.

Everes comyntas, Tailed Blue (163)

While quite common throughout the open parts of the Arboretum, this butterfly is not nearly so abundant as it has been found in other parts of the County. It flies nearly continuously throughout the season, with four principal broods, in late April to May, mid-June to mid-July, mid-August, and mid-September to November. It is very variable, both seasonally and individually; spring specimens (which tend to occur along the wood trails in area 3) are a richer, iridescent purple-blue, with more distinct markings beneath, while summer females tend to be brown or gray, and both sexes somewhat duller beneath. The food plant is White Clover (*Trifolium repens*).

Lycaenopsis argiolus, Spring Azure (169)

This species has perhaps the most involved brood sequence of all the Arboretum butterflies. In April a few individuals appear in the woods in area 3. These are mostly of the small, brightly colored form *violacea,* with a few darker ones called *marginata*. About three weeks later, in mid-May, a few very large, brightly colored individuals, form *neglecta-major,* appear in the woods. No more butterflies of the species are seen until mid-June through late July, when the full summer brood, *pseudargiolus,* is on the wing. This brood strays farther from the woods, often appearing in the southeastern part of section 1 (b) and visiting the Milkweed there. A very few individuals remain on the wing from late July through September, representing a partial third brood.

The variation in this species is remarkable, and is accentuated by the marked sexual dimorphism. Early spring females are usually solid blue above, while later ones are largely white; while males range from light, silvery-blue to pale violet.

The food plants in the Arboretum are *Cornus florida* and *Viburnum acerifolium*.

Family Papilionidae

Papilio polyxenes, Black Swallowtail (172)

The Black Swallowtail is a common species at the Arboretum and elsewhere in the area. It has been taken in areas 1 (a), 1 (b), 2, and 3, and is strongly a denizen of open spaces.

There are three annual broods, in mid-April to May, mid-June to early July, and early August to October. The species is subject to extensive variation. Spring and fall specimens have much larger yellow spots than summer individuals; and, thanks to the "basin effect", the "cold weather" forms are relatively more frequent here than elsewhere in the region. The food plant is the common Wild Carrot, *Daucus Carota*.

Papilio glaucus, Tiger Swallowtail (175)

The Tiger Swallowtail is one of the commonest of the Arboretum butterflies. It has been found in every section, both wooded and open. There are three broods, in late April to May, mid-June to mid-July, and mid-August to mid-September. The food plant is *Prunus pennsylvanica*, and it is likely that the Tulip Tree, *Liriodendron tulipifera*, is also used.

One of the most interesting facts concerning this species is the ocurrence of the black form of the female, which is so different in marking as to be hardly recognizable as the same species. This form is rather frequent at the Arboretum, comprising perhaps 25% of the female population; many of these have a yellow crescent at the end of the discal cell of the forewing.

Papilio troilus, Spicebush Swallowtail (178)

Another very common species, which has also been found in every Arboretum environment. It is more partial to wooded areas than the Tiger Swallowtail, however, and is perhaps commonest in the woods of area 3. It also has three broods, centered in early May to June, mid-July, and late August to mid-September. The food plant at the Arboretum is Spicebush (*Lindera Benzoin*). It has also been recorded elsewhere in the area on Sassafras. The species is subject to a marked degree of variation, largely seasonal.

Graphium marcellus, Zebra Swallowtail (179)

This very interesting species was taken once at the Arboretum, July 27, 1962, in area 3, at the edge of the Azalea-Rhododendron plantings. It is uncommon in the area, and is usually found in close association with its food plant, Papaw (*Asimina triloba*). At Whitemarsh there are two broods, late April into June and late July to August.

Battus philenor, Blue Swallowtail (180)

The Blue Swallowtail is an uncommon insect in the Philadelphia area, but has been taken once at the Arboretum, a female, July 9, 1962, on Milkweed along the stream in section 1 (b) southeast of Northwestern Ave. There are three broods in the area, the flight periods being late May to early July, early August, and September; and larvae have been found on *Polygonum Convolvulus*, although not at the Arboretum.

Family Pieridae

Anthocharis genutia, Falcate Orange-Tip (182)

The Falcate Orange-Tip is a rare insect around Philadelphia, occurring sparsely along much of the Wissahickon Creek. At the Arboretum, two specimens are recorded, both from area 3, on the trails down by the Creek, April 27, 1959, and May 5, 1961. The food plant at the Arboretum is not known, but the species is generally associated with Cruciferous plants. The female lacks the orange spot that gives the species its name.

Colias philodice and C. eurytheme,
Common Sulphurs (183-85)

These two forms, which have generally been considered good species although they probably are not, are both abundant at the Arboretum and throughout eastern Pennsylvania. The greatest concentrations are in section 1 (a), especially on the upward (northeast) slope, but the insects are common enough in section 1 (b), much of area 2, and are rarely seen in the more open parts of 3. The variation in these butterflies is so extensive that it cannot be treated here.

There are four broods at the Arboretum, centered in late April to May, mid-June, mid-July to early August, and September to October. There are always a few *Colias* flying during the warm season. In advanced seasons there is sometimes a partial fifth brood on the upslope of the Mt. St. Joseph tract (section 1 (a)) in early November.

About one-fourth of all of the females at the Arboretum are of the white form *"alba"*, or somewhat less than the general average for the Philadelphia area. The form *"ariadne"* is of frequent occurrence.

The food plants at the Arboretum, as elsewhere, are principally the Red and White Clovers (*Trifolium pratense* and *T. repens*). Elsewhere, the insects have begun to feed on the Sweet Clovers, *Melilotus*, but these weeds have not yet appeared on the Arboretum grounds.

Zerene caesonia, Dog's Head (189)

The uniquely marked *caesonia* is a southern species which appeared briefly at the Arboretum

in the late summer of 1961 as a part of a general northward movement of species of the southern coastal plain. It had reached Maryland in 1960.

Seven specimens were taken, all in field 1 (a), although one was seen across Stenton Ave., in section 1 (b). Six of these were males; one female — of the form *"rosa"* — was taken September 13, the last *caesonia* of the season. It had light spots inside the fore-wing borders, an exceptional condition for the species and possibly the result of hybridization.

The Dog's Head is a swift-flying insect, not easily caught. As the species did not reappear in 1962, it may be assumed that it is incapable of surviving our northern winters, and that its appearance here is dependent upon migration from the south. The food plant is *Amorpha*.

Pieris rapae, Cabbage White (200)

This unmitigated pest and ubiquitous nuisance, an importation from Europe, has spread fully as quickly as the introduced weeds on which it feeds and may now be found all over the United States. The Arboretum is no exception, and the species is quite common there in sections 1 (a), 1 (b), and 2, and is occasionally seen in 3 and 4, mostly in early spring.

There are five broods at the Arboretum: late March to May, mid-June, late July to August, September, late October to late November. The early and late broods are predominantly of the "cold weather" form, *immaculata*, which is paler above and darker below. The Cabbage White has been reared on fourteen species of native and wild, introduced, and garden Cruciferae, and may be supposed capable of feeding on any species of that monotonous plant family.

Pieris protodice, Checkered White (202)

This attractive species is interesting primarily because females are caught much more frequently than males. The cause of this is undoubtedly the close resemblance of the males to the preceding species. The sexual dimorphism is striking in this species.

The butterfly ocurs in sections 1 (a) and 1 (b), and has four broods each year, in May, mid-late July, late August to early September, and late October. The food plants are Shepherd's Purse (*Capsella Bursa-pastoris*) and Virginia Peppergrass (*Lepidium virginicum*) at the Arboretum.

Spring specimens are smaller, with reduced markings above and more extensive gray-green scaling beneath. The species is not very common, only six or seven specimens being seen at the Arboretum each year.

Family Hesperiidae

Epargyreus clarus, Silver Spotted Skipper (206)

A very common species in the Medicinal Garden-greenhouse-rhododendron areas of section 3, less common elsewhere, at the Arboretum. It has been seen or taken in all parts, however. There are two broods, in early May to late June and early July to September. The active, pugnacious Silver Spot is a conspicuous species on the lilacs in June, and on Milkweed in July. It feeds on *Robinia* and *Wisteria*, and many larvae may be found in most seasons on the large *Wisteria* near the greenhouse.

Thorybes pylades, Northern Cloudy Wing (212)

This species is found rather uncommonly, in area 3 only. It has been found mainly in the ecotonal area where the woods merge into the meadow near the Wissahickon. It has one annual brood only, in May through early July, and its food plant at the Arboretum is not known. It is a fast flier, and quite wary.

Pyrgus communis, Checkered Skipper (215)

P. communis is a common species in areas 1 (a) and 1 (b), and has been found on the Whitemarsh Country Club grounds as well. It is a swiftflying, pugnacious species, and visits *Centaurea* blossoms avidly.

There are three broods, in mid-May, mid-July, and late August through November, and at the Arboretum, the last brood is invariably the largest. The food plant is *Abutilon Theophrasti*.

Pholisora catullus, Common Sooty Wing (216)

Another common species found in sections 1 (a) and 1 (b). The Sooty Wing has three broods, centered in early May to June, July, and late August to September. It is subject to much variation in the size and number of the small white spots on the wings. The food plant, at the Arboretum and elsewhere, is Lamb's Quarter, *Chenopodium album*.

Genus Erynnis, Dusky Wings (200-227)

A number of Dusky Wings, all very similar and difficult to identify correctly, occur along the Wissahickon and have been taken in area 3 of the Arboretum. They occur along the wood trails and in clearings, especially around moist ground. The species which have been found in the Arboretum are *E. icelus*, *E. horatius*, *E. persius*, and *E. baptisiae*. The larvae of the first only have been observed there; their food plant is Aspen, *Populus tremuloides*. None of the species is common.

Ancyloxipha numitor, Least Skipper (231)

The tiny Least Skipper is quite common in sections 1 (a), 1 (b), and 1 (c). It is a denizen of moist ground, and flies low, along the banks of the smaller streams. There are two broods, in mid-May to early July and mid-August to late September. It and all of the following feed on grasses.

Hylephila phylaeus, Fiery Skipper (241)
A common species in section 1 (a), 1 (b), and 4. It is essentially a southern species, but seems able to survive our winters well. It is inordinately fond of *Vernonia* blossoms. The sexual dimorphism is striking. There are three broods at the Arboretum: mid-May (rare), late June to July, and late August to November.

Hesperia sassacus, Indian Skipper (238)
This scarce insect has been caught once (May 28, 1961) along the trail which overlooks the Wissahickon on the southeast bank, in area 3. It is a typical Alleghenian species.

Polites verna, Little Glassy Wing (245)
A rather infrequently caught species, which has been found in area 1 (a). It has only one brood, in late June to early July.

Polites manataaqua, Cross Line Skipper (245)
The Cross Line Skipper and its close relative, the Tawny Edged Skipper, are very similar in appearance but differ widely in choice of habitats. *Manataaqua* is a resident of upland, dry, long-blade grass fields, while *themistocles* prefers damp, low, even marshy situations. *Manataaqua* has been taken four times on the upslope of section 1 (a), almost up to the school building. It has two broods, in mid-June and August.

Polites themistocles, Tawny-Edged Skipper (246)
A very abundant, widespread species, the Tawny Edged Skipper is found predominantly in areas 1 (a) and 1 (b), especially in the wetter spots. It has been taken a few times in area 4 also. The species has two broods, the first being in early June to mid-July and the second in early August to September. The population densities which this species has achieved at the Arboretum are striking. In 1962, especially, several hundred could be collected in an afternoon.

Polites peckius, Peck's Skipper (246)
A generally common species in the Philadelphia area, *peckius* is less so at the Arboretum. It has three broods, in mid-May to mid-June, late July to early September, and early October, and flies in areas 1 (a) and 1 (b).

Poanes zabulon, Zabulon Skipper (250)
This species is, like the preceding two, very abundant throughout the area, but it is rather infrequently taken at the Arboretum. It has been found only in area 4, where it has two broods, flying in late May to late June and early August to mid-September. The sexual dimorphism in this species is very remarkable.

The similar and likewise common *P. hobomok* has not been found at the Arboretum.

Atrytone conspicua, Black Dash (258)
The Black Dash is a scarce, local species, which has been found only in sections 1 (b) and 1 (c) of the Arboretum in the entire Philadelphia area. Despite its trivial name, it is anything but conspicuous, the males resembling *Polites manataaqua* and the females *P. peckius*. The insect has one brood only, with a short flight period, in early July. It has been taken on both sides of Northwestern Avenue.

Atrytone ruricola, Dun Skipper (258)
This is yet another example of a species, abundant throughout much of the region, but scarce and sharply localized at the Arboretum. It has been found in exactly the same places as *P. zabulon,* in area 4. There are two broods, in mid-May to early July and late August to late September. Both this and *zabulon* are most common at the same place where *Polygonia progne* was taken (*qv.*).

Lerodea l'herminieri, Swarthy Skipper (266)
A rather common insect in sections 1 (a) and 1 (b), flying with *Polites themistocles,* which it resembles on the under side. There are two broods, in mid-late June and early August to mid-September. Some specimens are much more "swarthy" than others. This is a southern species which has been steadily increasing its range northward. It definitely did not occur around Philadelphia fifty years ago.

Amblyscirtes vialis, Roadside Skipper (262)
This uncommon insect appeared in section 1 (b) of the Arboretum for the first time in 1962, in both broods, and perhaps it will become established there. Its nearest established colony is believed to be near Norristown. The two flights are in late May to early June and late July to early August.

Panoquina ocola, Southern Skipper (270)
This southern migrant has been caught once at the Arboretum, in section 1 (b), October 31, 1958. It is a not infrequent stray up the coast in the fall.

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Arboretum Activities

(Continued from Page 22)

Edith C. Gall

It is with deep sorrow that we report the death, on May 6, of Mrs. John F. Gall. For several years Edith Gall had been a member of the Arboretum family, teaching in the summer course, collecting for the Herbarium and contributing articles to this Bulletin. At the time of her death she was collaborating with the Director in a study of the genus *Stewartia*. Her contagious enthusiasm and fine spirit of cooperation will be sorely missed by all of us.

The First Barnes Lecture

The first lecture in the newly established Laura L. Barnes Lectureship series took place on Tuesday, April 16.

Dr. John S. L. Gilmour, the distinguished Director of the University Botanic Garden at Cambridge, England, gave an illustrated talk on the Cambridge Botanic Garden.

Since the Arboretum lacks facilities for a function of this magnitude, the lecture was held in the auditorium of the Springside Upper School with more than 350 persons in attendance.

From Our Guest Book

The following are among those who have recently visited the Arboretum:

- Dr. Walter H. Hodge, National Science Foundation, Washington, D.C.
- Dr. Frits W. Went, Director Missouri Botanical Garden, St. Louis, Mo.
- Dr. Eugene Ogden, New York State Museum, Albany, N.Y.
- Dr. John S. L. Gilmour, Director University Botanic Garden, Cambridge, England
- Wilfrid Blunt, Watts Gallery, Compton Surrey, England
- Dr. Frank B. Galyon, Knoxville, Tenn.
- Dr. Jean Langenheim, Gray Herbarium, Cambridge, Mass.
- Dr. Richard A. Howard, Director Arnold Arboretum, Jamaica Plain, Mass.
- Dr. Alfred L. Bogle, Dept. of Botany, University of Minnesota.

Arboretum Brochure

There is now available a new four-page brochure containing a map of the grounds (showing the location of principal land-marks and major plant groups) and a brief account of the history and salient features of the Arboretum and also information as to our location and means of access. The map is the work of Miss Joan Taylor, formerly a member of the Arboretum staff.

Copies of this leaflet will be sent upon request.

Slides and Postals

The Arboretum now offers a set of twelve kodachrome transparencies taken within the grounds. These include such general views as the Swan Pond the Rose Garden and the Rock Wall as well as pictures of individual plants. These slides sell for 35 cents each or three for a dollar, plus tax.

Also available is a set of six color post-cards which are priced at five cents a piece or six for a quarter.

A complete list of the subjects represented in both slides and postals will be mailed upon request.

J. M. F., Jr.

Associates' Corner

A Man of many Parts

Legend has it that at one time James J. O'Neil was apprentice to a tin-smith on the Hill. However this may be, we do know that as a young man he worked for the Pierce Arrow Company. It is at about that time that he enters our story.

When, shortly before World War I, Miss Lydia T. Morris, our benefactress, decided to abandon the horse in favor of a motor vehicle her choice fell upon the Pierce Arrow. Since her coachman either couldn't or wouldn't undertake to pilot this horseless carriage, the services of young Jim O'Neil were enlisted and he became chauffeur, mechanic and guardian of this dangerous contraption.

When the trumpets sounded Jim went off to war and served his country well on the battlefields of France. He had the somewhat dubious distinction of being the first American doughboy to contract anthrax from the wool used in his trench coat.

Following the armistice Jim returned to Compton and resumed his ministrations over the ancient Pierce Arrow and a whole line of its successors, becoming Miss Morris' right hand man.

When the Morris property came to the University, following Miss Morris's death in 1932, James O'Neil was appointed Custodian of Buildings and Equipment. Even this high-sounding title does not begin to describe the multitudinous services which Jim has rendered the Arboretum over a thirty-year period.

Not only has he mounted guard over the buildings on the grounds, seeing to it that painting, papering and plumbing were kept in apple-pie order; but has played nursemaid to mowers, tractors, trucks, station-wagons and jeeps, taking precautions to prevent breakdowns and repairing them when they occurred.

In addition to all this, Jim has personally supervised the maintenance of the two miles of iron fence which surround the property. This has entailed the scraping and application of two coats of paint to a given fraction of it each year so that in due course (about seven years) it all gets done just in time to start doing it all over again.

When he wasn't attending to a myriad of other chores, Jim found time to supervise the spraying program, look after the complicated system of underground pipes and drains, described in an earlier Bulletin and, in the winter season, see to it that roads were kept open. He was also charged with the task of shopping and buying supplies for the Arboretum, a job in itself.

Built like an all-American tackle, endowed with a magnificent physique, and possessed of sparkling, clear blue eyes, Jim O'Neil is the gentlest of giants. His unfailing good humor, his readiness at all times to respond to all that is asked of him and more, his fine spirit of cooperation and leadership, all of these have made him over the years an outstanding asset to the Morris Arboretum family.

Although, like John Tonkin and Tom Carney, Jim is now on the retired list, you would never know it for hardly a day passes that he is not seen somewhere about the place doing almost anything that needs to be done and spreading a spirit of good will while doing it.

Marion W. Rivinus

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since March, 1963

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Mrs. Charles E. Bowers, Jr.
Mrs. R. T. Boyd, III
Mrs. Charles Bruce Campbell, Jr.
Mrs. Edward C. Cassard
Mr. John M. Cheezum, Jr.
Mrs. Harry E. Dreisbach
Mrs. Ruth P. Hughes
Mrs. Fred Loffredo
Mrs. Daniel S. Merritt
Mrs. John B. Muir
Mrs. George F. Nordblom
Mr. Charles A. Olson
Mrs. Alexander Robinson
Mr. T. D. Sharples
Mr. Richard M. Spurgeon
Mr. John W. Tiley
Mr. J. M. Wallace
Mrs. Benjamin W. Watson
Mr. Ralph J. Wickel

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Mahonia Bealei

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year
Donor	$500.00		

Arboretum Activities

The Staff

The Director has recently been elected to the Board of Trustees of the Fairmount Park Art Association. On August 18 and 19 he attended the Michel Adanson Bicentennial Symposium which was held at the Hunt Botanical Library in Pittsburgh.

Dr. Li spent the month of July at the Herbarium of Harvard University continuing his studies on the flora of Taiwan. His book on "The Woody Flora of Taiwan" appeared in August as did his volume on "The Origin and Cultivation of Shade and Ornamental Trees." Both of these books are part of the Arboretum's Series of Monographs and both are reviewed in this issue.

During June and July Dr. Allison taught a course in Mycology at the University of Guayaquil, Ecuador. While there she continued her field studies of the Myxomycetes.

A Heath Garden

Our policy of attempting to bring together in one place all of the members of an important family or group of plants has frequently been mentioned in these notes. Our most recent endeavor has been the creation of an area to accommodate most of the genera belonging to the Ericaceae or Heath Family. This family, in addition to including the azaleas and rhododendrons, the

(*Continued on Page 53*)

The Cultivated Mahonias

Hui-Lin Li

Mahonia is a genus of ornamental shrubs valued for both their highly decorative foliage as well as fruits. The various species are erect evergreen bushes of low to medium stature. Their leaves are large and pinnately compound, with several to many leathery, glossy, dark green, and generally sharp-toothed leaflets. The individual flowers and fruits are small but they are borne in large clusters. The flowers are of a pleasing yellow color and the fruits of the unusual color of blue. The plants are thus not only useful for outdoor plantings but are also desirable for interior decoration. In the Philadelphia area the species mostly flower around May or occasionally as early as January, and bear fruits from July to September.

Mahonia is a genus very closely related to *Berberis,* the Barberries, differing primarily in the compound rather than simple leaves. Because of the larger, pinnate leaves and the evergreen habit, these plants are more ornamental than the true Barberries. In the nineteenth century, these two were included in the same genus, thus nearly all species of *Mahonia* were once known as *Berberis.* In more recent times, the two are more generally maintained as distinct, but occasionally they are still treated as congeneric in botanical publications. In horticultural writings and in the trade, the species of *Mahonia* often appear under *Berberis.*

The single universal character distinguishing all species of *Mahonia* from *Berberis* is the pinnate foliage. In addition, there are several other characters sometimes used to separate the two genera, but these apply only to the majority and not all of the species. All *Mahonia* species are unarmed on the stem, while nearly all *Berberis* are spiny-stemmed with only a few unarmed species. In the inflorescence about three-fourth of the species of *Mahonia* have a fascicle of dense spike-like racemes, a type not found in *Berberis.* The remaining one-fourth of the *Mahonia* species have simpler inflorescences as in *Berberis.*

Like the true Barberries, most of these handsome plants are unfortunately susceptible to the black stem rust of wheat, a fact restricting their value as ornamental plants. Some species, however, as the widely planted *M. Aquifolium, M. nervosa,* and *M. repens,* are immune or highly resistant to the rust. Because of this rust-susceptibility character, various species are under quarantine restriction by the United States Department of Agriculture. The Department issues a list, "Quarantine 38", with many revisions which govern the interstate shipment of *Berberis* and *Mahonia.*

Taxonomic Studies

Fedde gave the first thorough taxonomic treatment of the genus *Mahonia* (Fedde 1901). Subsequently Takeda (1917) revised in detail the Old World species. The latest treatise is by Ahrendt (1961) in which two subgeneric divisions, called by him "groups", are distinguished. The first group, Orientales, comprising the section Longibracteatae of Fedde, is characterized by the long and persistent bracts (1-4 cm. long) of the inflorescences. There are about 64 species, all distributed in the Old World from the Himalayas to China and southern Asia. The second group, Occidentales, made up of the three remaining sections of Fedde, namely, Aquifoliatae, Paniculatae and Horridae, are characterized by the short and deciduous bracts (2-8 mm. long) of the inflorescences. The group is restricted to the New World with about 43 species distributed in western North America from British Columbia to Mexico, Guatemala, Costa Rica and Cuba.

Mahoberberis

As mentioned before, the two genera *Berberis* and *Mahonia* are very close botanically. Horticulturally this closeness is indicated by the production of several successful crosses between species of the two genera (Ahrendt 1961). Two such bigeneric crosses are represented in the Morris Arboretum collection, × *Mahoberberis Neubertii* (Baumann) Schneider (*B. vulgaris* × *M. Aquifolium*) and × *Mahoberberis aquisargentia* H. Jenson (*B. Sargentii* × *M. Aquifolium*). The species have leaves varied from simple to pinnate, showing their mixed lineage. The stems are unarmed and the leaves are solitary as in *Mahonia.* The author of the latter is given as Krüssmann 1950 by Ahrendt, who apparently overlooked H. Jenson's earlier name of 1946 (Rehder 1949).

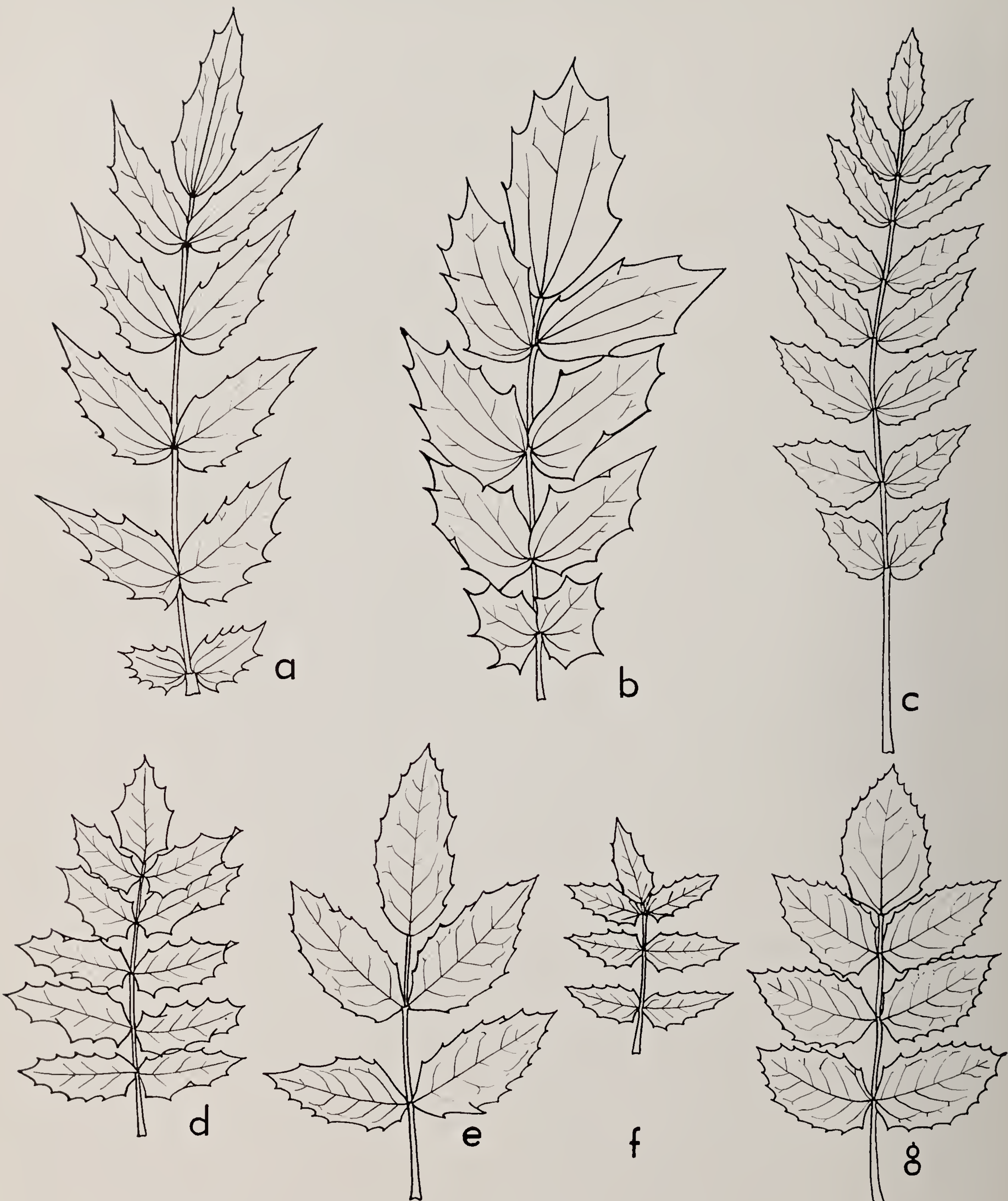

Fig. 19. Leaves of *Mahonia*. × ½. a, *japonica;* b, *Bealei;* c, *nervosa;* d, *pinnata;* e, *Aquifolium;* f, *Fremontii;* g, *repens.*

The Cultivated Species

Many species of *Mahonia* are now in cultivation, some more generally in gardens all over the world and others, primarily because of limited hardiness, restricted to certain areas. Still others are newer introductions into cultivation and may be found only in some of the botanical gardens.

In general species of *Mahonia* are easy to grow and there is no special requirements of soil needed. The plants can be raised more readily in sites where soil is good, deeply prepared and neither too dry nor wet from poor drainage (Morrison 1962).

The following is a listing of species recorded in current literature as occurring in cultivation. They are arranged alphabetically. The chief authorities on geographical occurrence of cultiva tion are Rehder (1940) for eastern North America, Mathias and McClintock (1963) for western North American, Ahrendt (1961), Bean (1951)

List of the Cultivated Species

Species	Origin	Cultivation	Reference	Notes
M. acanthifolia G. Don	Nepal, India	England Europe	Ahrendt Krüssmann	
M. Aquifolium (Pursh) Nutt.	W.N. Am.	*General*		
M. Bealei (Fort.) Carr.	China	*General*		
M. Ehrenbergii (Kunze) Fedde	Mexico	(?)	Ahrendt	(A)
M. Fortunei (Lindl.) Fedde	W. China	Europe England SE. U. S. (?) E. Asia	Krüssmann Bean Rehder	(B)
M. Fremontii (Torr.) Fedde	SW. U. S.	*General*		
M. gracilis (Hartw.) Fedde	Mexico	Europe SE. U. S. (?)	Krüssmann Rehder	
M. haematocarpa (Woot.) Fedde	W.N. Am.	SE. U. S. (?)	Rehder	
M. japonica (Thunb.) DC.	Japan	*General*		
M. lomariifolia Takeda	W. China	England Europe W.N. Am.	Ahrendt Krüssmann M. & M.	
M. Muelleri Johnston	Mexico	England	Ahrendt	(C)
M. napaulensis DC.	Nepal	Europe	Krüssmann	
M. nervosa (Pursh) Nutt.	W.N. Am.	*General*		
M. Nevinii (Gray) Fedde	S. Calif.	Europe W.N. Am.	Krüssmann M. & M.	
M. pinnata (Lag.) Fedde	W.N. Am.	*General*		
M. piperiana Abrams	Calif.	Europe	Krüssmann	
M. pumila (Greene) Fedde	W.N. Am.	England	Ahrendt	
M. repens G. Don	W.N. Am.	*General*		
M. siamensis Takeda	Thailand, Yunnan	England	Gilmour	(D)
M. Swaseyi (Buckley) Fedde	Texas	Europe SE. U. S.	Krüssmann Rehder	
M. trifoliolata (Moric.) Fedde	SW. U. S.	Europe England SE. U. S.	Krüssmann Ahrendt Rehder	(E)
M. Wilcoxii (Kearney) Rehder	Arizona	E. U. S.		(F)

for Great Britain and Krüssmann (1962) for Continental Europe. Uncertain cases are indicated with a question mark. Hybrid species are not included in this enumeration.

Notes

(A) *M. Ehrenbergii*
Described from material cultivated in Halle Botanical Garden 1844. (Ahrendt 1961). It is not certain whether the plant is still in cultivation.

(B) *M. Fortunei*
Krüssmann, Rehder, as well as Bean (1951), record it as in cultivation in Europe, the eastern United States and England respectively. Ahrendt (1961), however, gives its occurrence in cultivation as in Shanghai, China, only. Makino (1951) notes its long cultivation in Japan, introduced there in former times from China.

(C) *M. Muelleri*
This Mexican species was first described by I. M. Johnston in 1950. Ahrendt (1961) gives its only instance of cultivation, based on a specimen as yet unflowered.

(D) *M. siamensis*
Cultivated only at Cambridge University under glass (Gilmour 1963). It was introduced by Forrest from Yunnan, China, in 1931.

(E) *M. trifoliolata*
Ahrendt notes that in England it is the grayish variety var. *glauca* I. M. Johnston, that is in cultivation.

(F) *M. Wilcoxii*
This plant of the western United States is still treated as a species of *Berberis* in Kearney and Peebles, Arizona Flora, 1951 (as *Berberis Wilcoxii* Kearney). Rehder made the combination in Bailey's Standard Cyclopedia of Horticulture in 1916 but this species was overlooked by Ahrendt in his otherwise quite complete mono-

Fig. 20. *Mahonia Bealei*

Fig. 21. Flowers of *Mahonia Bealei*

graph of the genera *Berberis* and *Mahonia* (Ahrendt 1961). This species is allied to *M. Aquifolium*, but differs in having smaller very coriaceous leaflets ovate in shape and with only 3 to 5 spreading spiny teeth on each side. The species occurs in Arizona. It is now being cultivated by Mrs. J. Norman Henry in Gladwyne, Pennsylvania and is seemingly hardy for this area. Another species overlooked by Ahrendt is **Mahonia Harrisoniana** (Kearney & Peebles) comb. nov. (*Berberis Harrisoniana* Kearney in Jour. Washington Acad. Sci. 29: 477. 1939). This is a little known species from southwestern Arizona not yet in cultivation.

Key to the Common Species

For the seven generally cultivated species, a key based primarily on vegetative characters for ready identification is given below. Descriptions of these species as well as other pertinent notes follow. No attempt is made here to list the cultivars in some of the species. A drawing showing a typical leaf of each of these species is also given (Fig. 19). The Morris Arboretum collections at present contain the majority of the species except the more tender ones, M. *japonica* and *M. repens*.

A. Leaves with a smaller basal pair of leaflets near the base (Asiatic species).
- B. Leaflets narrow, 2-3.5 times as long as broad; terminal leaflets narrow; racemes 10-20 cm. long, pendulous. 1. *M. japonica*
- B. Leaflets 1-1.5 times as long as broad; terminal leaflets broad; racemes 5-10 cm. long, erect. 2. *M. Bealei*

A. Leaflets without a smaller basal pair of leaflets near the base (American species).
- B. Leaflets 7-19, spiny-dentate.
  - C. Leaflets 9-19, rigidly coriaceous; petioles very long, 4-12 cm. in length. 3. *M. nervosa*

C. Leaflets 7-13, leathery; petioles very short, 0.5-2.0 cm. in length.
4. *M. pinnata*

B. Leaflets 3-9, spiny-dentate or with a few large teeth.

C. Leaflets rigidly coriaceous, with very few large teeth; petioles very short.
5. *M. Fremontii*

C. Leaflets leathery, spiny-dentate, petioles 2-5 cm. long.

D. Leaflets 5-9; petioles 2-5 cm. long.
6. *M. Aquifolium*

D. Leaflets 3-7; petioles 2-3 cm. long.
7. *M. repens*

1. *Mahonia japonica* (Thunb.) DC.
Japanese Mahonia
(*Berberis japonica* (Thunb.) R. Brown)
Fig. 19a

A shrub 3-4 m. high, the stems erect, stiff. Leaves to 30 cm. long; leaflets 9-15, thickly and rigidly coriaceous, ovate-oblong, variable in size, 4.5-10 cm. long, 2-4 cm. wide, generally with 1-3 teeth on the upper and 5-6 teeth on the lower margin, dark shining green above, yellowish green beneath, the base rounded to subtruncate, the lateral leaflets slightly oblique, the lowest pair smaller, the terminal leaflet narrow, about 6-10 cm. long and 4 cm. wide. Racemes 10-20 cm. long, more or less pendulous, about 10 together, laxly fascicled; flowers about 7 mm. long, the bracts ovate, about 2-4 mm. across, the pedicels 6-7 mm. long, slender; stamens with the apex incised with rounded lobes; style very short. Berries ovoid, about 8 mm. long and 4 mm. broad, dark purple, bloomy.

Fig. 22. *Mahonia Bealei* in flower

Fig. 23. *Mahonia Bealei* in fruit

The plant is probably native to southeastern China and Taiwan (Formosa) and in all probability occurs only in cultivation in Japan. According to Makino (1951), it was introduced into Japan from China in the Tang dynasty (7th-9th century). Takeda (1918) believed the plant to be the same as *M. tikusiensis* Hayata, a species indigenous to Taiwan mountains. This view is followed by other authors on the Taiwan flora (Li 1963). Although Ahrendt (1961) maintained *M. japonica* as distinct from *M. tikusiensis* he did not actually have access to any specimens from Taiwan.

There is considerable confusion in the naming of *M. japonica* and *M. Bealei* in the horticultural trade. The difference between these two species has been discussed fully by Takeda (1917) and Mulligan (1935) and more recently also by McClintock (1961). *Mahonia japonica* is apparently not common in American gardens, and the plants generally called *M. japonica* are actually *M. Bealei*. See further discussions under the latter species.

This is a tender species most probably not hardy in the Philadelphia area. It flowers in early spring in February to March. Van Melle (1947) traces the earliest records of its cultivation in Western gardens to its introduction to Chiswick in 1853 as recorded in Illustr. Hortic. 1854.

Fig. 24. *Mahonia Aquifolium*

2. *Mahonia Bealei* (Fortune) Carr.
Beale's Mahonia

(*Berberis Bealei* Fortune)
Cover, Figs. 19b, 20-23

A shrub to 4 m. high, the stems erect. Leaves very large, to 45 cm. long and 20 cm. broad; leaflets 5-9, sometimes to 15, rigidly coriaceous, ovate, 5-12 cm. long, 4-6 cm. wide, with 3-6 large spiny teeth on each margin, dark shining green above, glaucescent beneath, the lateral ones very oblique at base, the lowest pair much smaller (3-4 cm. long, 1.0-1.5 cm. wide), inserted near the base of the petiole, the terminal leaflet stalked, much larger, to 20 cm. long and 12-14 cm. wide, with broadly cuneate to subrounded bases; petioles 1-2 cm. long. Racemes erect, stout, 5-15 cm. long, 6-9-fascicled, the flowers light yellow, fragrant, crowded, the basal bracts 10-15 mm. long, the pedicels about 5 mm. long; stamens not produced, rounded-truncate; style 0.1 mm. long or lacking. Berries ovoid, bluish black, about 10 mm. long and 6 mm. wide.

This is a vigorous grower with large leaves and large clusters of pale yellowish fragrant flowers. It is the earliest blooming species. The flowers open in winter, usually in January and February.

Robert Fortune found this species in 1848 in a Chinese garden in "Hwey-chow" (Hueichow of Anhwei province) in eastern China and introduced it into England (Fortune 1850). He named it *Berberis Bealei,* as he first grew it in Mr. Beale's garden in Shanghai. It was subsequently treated by various authors as a variety of *Mahonia japonica*. As a result, in their cultivated state the two species are often confused with each other and frequently *M. Bealei* is erroneously called *Mahonia japonica* or *Berberis japonica*. The two can be readily distinguished by their racemes, which are erect in *M. Bealei* and pendulous in *M. japonica*. In cultivation, *M. Bealei* is a much hardier plant than *M. japonica*. It also has larger broader and more rounded leaflets with fewer spines. The flower stalks are shorter and the flowering racemes are also more slender.

In the gardens of eastern China, this species has long been cultivated. Fortune recorded the Chinese name "Shae-ta-kong-la", which should be more accurately romanized as "Shih-ta-kung-lao", meaning "Ten big virtues", apparently referring to its many uses as a medicinal plant.

3. *Mahonia nervosa* (Pursh) Nuttall
Oregon Grape
(*Berberis nervosa* Pursh) Fig. 19c

A low suckering shrub to hardly 0.5 m. tall, the stems bearing persistent narrow bud-scales 2-3 cm. long. Leaves 40-60 cm. long; leaflets 7-21 (mostly 11-15), rigidly coriaceous, ovate to ovate-lanceolate, 4-7 cm. long, 2.5-3.5 cm. wide, the margins 8-15-spinose-serrate, subconcolored, lustrous and somewhat more greyish above, dull and more yellowish beneath, the lateral leaflets oblique, prominently 3-5-nerved at base; petioles 5-12 cm. long. Racemes erect, 10-20 cm. long, 2-4-fascicled; flowers bright yellow, to 6 mm. long, the bracts 2-3 mm. long; stamens edentate; style very short or lacking. Berries globose, 6-9 mm. across, dark blue and bloomy.

This species is native to British Columbia, Idaho, California, Washington and Vancouver Island.

The plant is a very low one but with relatively large and very long-petiolate leaves. The leaflets are thick, rigid and shining. It is one of the more hardy species from western North America and is now very widely cultivated. According to Rehder (1940) it was introduced into cultivation in 1822.

4. *Mahonia pinnata* (Lagasca) Fedde
(*Berberis pinnata* Lagasca) Fig. 19d

An upright shrub 1-4 m. high. Leaves with 7-13 leaflets; leaflets coriaceous, ovate, subequal, about 4-8 cm. long, 2-4 cm. wide, sinuately spiny-toothed, the teeth 6-12 on each side, lustrous above, green beneath, without distinct papillae, with conspicuous close impressed reticulations; petioles very short. Racemes 5-8 cm. long, 3-4-fascicled, axillary along the stem; flowers pale yellow, to 9 mm. long; pedicels 5-8 mm. long; bracts ovate, 1.5-2 mm. long, inserted at the middle of the pedicels; stamens 5.5 mm. long, dentate, the apex not produced and truncate. Berries globose, about 6 mm. across, purplish black.

This species is native from California and New Mexico to Mexico. According to Rehder, it was introduced into cultivation in 1819. Among the species discussed here, with the possible excep-

tion of *M. japonica*, this is probably the least hardy. It is represented only in the Arboretum nursery at the present and may be only barely winter-hardy in the Philadelphia area.

This species is close to *M. Aquifolium* in foliage but with fewer leaflets and these are slightly duller in appearance. The plants are also generally taller. There are two small bracts on the flower-pedicels while in *M. Aquifolium* the pedicels are bractless. The flowers are very fragrant.

5. *Mahonia Fremontii* (Torrey) Fedde
Fremont's Mahonia
(*Berberis Fremontii* Torrey) Fig. 19f

An upright shrub 1-4 m. high. Leaves about 3-10 cm. long; leaflets 3-7, thick and rigidly coriaceous, oblong-lanceolate, 2-6 cm. long, 1-1.5 cm. wide, dull bluish green, the margins 3-4-spinose-dentate, the terminal leaflets stalked, the lateral ones sessile to subsessile. Racemes 2-5 cm. long, fascicled or umbellate, each raceme 3-5-flowered, the flowers in axils of minute lanceolate bracts densely crowded toward the end of the racemes; flowers yellow, to 5 mm. long, on slender pedicels 8-12 mm. long; bracts 2, one below the calyx and another at the middle part of the pedicel; stamens dentate, the apex not produced. Berries ovoid, about 1.5 cm. long and 1 cm. wide, bluish black.

The species is native to western North America in Colorado, Utah, Arizona, California to northwestern Mexico including Lower California. Rehder (1940) gives the date of introduction into cultivation as 1895. Compared with other western North American species, *M. Fremontii* is less hardy than *M. Aquifolium* and *M. nervosa* but more so than *M. pumila*. While most other species of *Mahonia* prefer a shady site, *M. Fremontii* thrives best in a sunny position.

This species is notable for its small bluish green foliage and the relatively large bluish black fruit.

6. *Mahonia Aquifolium* (Pursh) Nuttall
Holly Mahonia
(*Berberis Aquifolium* Pursh)
Figs. 19e, 24, 25

A shrub to at most 2 m. tall, generally to 1 m. or less. Leaves 6-12 cm. long; leaflets 5-9, sessile or subsessile, rigidly coriaceous, ovate to oblong-ovate, 4-8 cm. long, 2-4 cm. wide, very lustrous and dark green above, without distinct papillae beneath, the margin with 6-12 slender spiny teeth on each side; petioles slender, 2-5 cm. long. Racemes erect, 5-8 cm. long, densely fascicled at end of branches; flowers golden yellow, to 9 mm. long, densely set on the racemes; pedicels 5-8 mm. long; bracts wanting; stamens 5.5 mm. long, dentate, the apex not produced, truncate. Berries globose, about 8 mm. across, bluish black, bloomy.

The species is a native of western North America from Vancouver Island southward to Washington and Oregon. It was first introduced into cultivation, according to Rehder (1940), in 1823. This record apparently pertains to Prince, Catalog 1822, which lists "Berberis Aquifolium, Mr. Lewis' Mountain Holly", as noted by Van Melle (1947).

This is a very hardy species much planted in this country and elsewhere. Many varieties have originated in cultivation especially in Europe. Most of these are probably of hybrid origin between this and various other species (Ahrendt 1961).

The species is not particular as to soil, but thrives best in a partly shaded position and is thus especially suitable for planting under deciduous trees. It can be readily propagated by seed or by dividing the old plants in spring. The plant spreads naturally by underground suckers. The leaves turn purple in winter.

7. *Mahonia repens* (Lindley) G. Don
Creeping Mahonia
(*Berberis repens* Lindley) Fig. 19g

A low, stiff, stoloniferous shrub $\frac{1}{3}$ to 1 m. high. Leaves 15-27 cm. long; leaflets 3-7, ovate, subequal, leathery, 3-6 cm. long, 2.5-4 cm. wide, dull bluish green above, with distinct papillae beneath, the apex rounded or subcordate, the margins spinulose-dentate; petioles 2-3 cm. long. Racemes 5-8 cm. long, 5-7-fascicled at end of

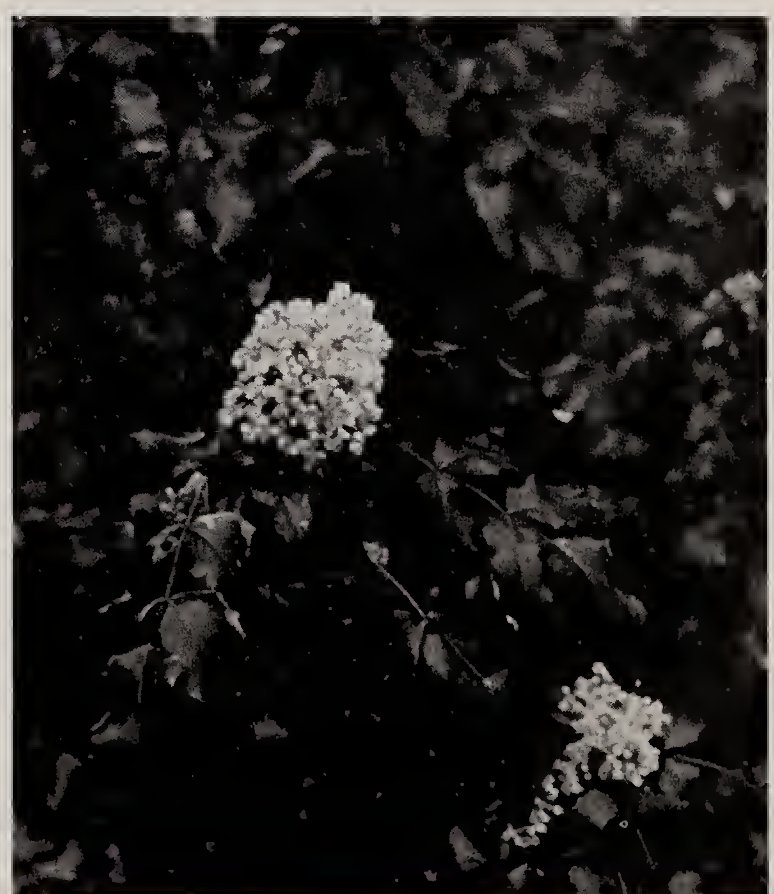

Fig. 25. *Mahonia Aquifolium* in flower

branches; flowers to 7 mm. long; pedicels 5-8 mm. long; bracts wanting; stamens dentate, the apex not produced, truncate. Berries globose, about 8-9 mm. across, bluish black, bloomy.

This species is native to western North America from British Columbia to New Mexico and California. It was first discovered during the well-known expedition of Lewis and Clark in 1804-1806. Rehder (1940) gives the date of first cultivation as 1822. Several varieties have since been developed in cultivation.

The plant is a low suckering shrub with spreading underground stems. It is similar to *M. Aquifolium* in general appearance but is less handsome. Both species are characterized by the absence of bracts on the pedicels. Among other characters it can be readily distinguished from *M. Aquifolium* by its dull bluish foliage. Furthermore these leaves do not change to purple in fall and winter as in *M. Aquifolium* (Piper 1922).

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Associates' Corner

A Man of Long Standing

We have many loyal friends at the Arboretum. One of the most loyal and certainly one of the most valuable is Joseph Costanza. Joe came to the Arboretum on April 3rd, 1901 and ever since then has never been late to work and rarely missed a day. He started in the Rose Garden, soon taking over the Rock Wall and pretty much everything in sight including the Fernery. They are monuments to his consciencious, tender, and skillful care. Today, although over eighty years old, Joe is the right hand Propagating Man with all that that entails, while keeping a constant touch on the Fernery, and with eagle glances at his first love, the Rose Garden.

I asked what particularly difficult plants he had succeeded in propagating? "Nothing is difficult for Joe" was the reply. I did elicit that when Dr. Fogg brought back some dreary, unhappy cuttings of the Bamboo Orchid from Honduras, Joe nursed them back to health and life and they are thoroughly established and flourishing.

Since Joe took over the propagating, more seed from Europe has been raised than for a long time, thereby furnishing new material for the Arboretum, and especially for its Medicinal Garden.

Just to keep occupied, this remarkable man lends an invaluable hand and green thumb to the annuals for bedding and practically every plant in the Medicinal Garden knows him personally. When you look at the interesting plants you have received from the Annual Distribution let them remind you of Joseph Costanza and all that he has quietly accomplished. One of Nature's Gentlemen, beloved by men and plants alike.

Marion W. Rivinus

Chromosome Number in Tsuga

Frank S. Santamour, Jr.[1]

The possible effects of polyploidy in plants include a reduction or an increase in growth rate, a reduction in the amount of branching, and an increase in the size of plant organs. The wide range of varietal forms of eastern hemlock suggested the possibility of polyploidy. This, coupled with the rarity of polyploids among conifers, prompted a cytological investigation of the available members of the genus *Tsuga* growing at the Morris Arboretum.

As in the majority of the Pinaceae, the normal haploid chromosome number of the hemlocks is $n=12$. Chromosome numbers for three species of hemlock have been reported[2], and all are diploids with $2n=24$. These species are *Tsuga canadensis* (L.) Carr. (eastern hemlock), *T. caroliniana* Engelm. (Carolina hemlock), and *T. diversifolia* (Maxim.) Mast. (Japanese hemlock).

Material for the present study was collected during the spring of 1962 from three species of hemlock, including five distinct forms of eastern hemlock. Cones were gathered when the cone scales had closed shortly after pollination. The endosperms (female gametophyte tissue) were dissected out and fixed in a 1:3 acetic-alcohol solution; then they were strained with acetocarmine following accepted squash techniques. The endosperm of conifers is a haploid tissue that is often used for cytological studies.

No polyploids were found among the species examined, even in the most bizarre forms. Chromosome counts of $n=12$ revealed that all of the following were diploid: *T. canadensis* 'Macrophylla', *T. canadensis* 'Jenkinsii', *T. canadensis* 'Albo-spica', *T. canadensis* 'Pendula', *T. canadensis* 'Atrovirens', *T. Sieboldii* Carr., and *T. chinensis* (Franch.) Pritz.

[1] Geneticist, Northeastern Forest Experiment Station, Forest Service U.S. Department of Agriculture. The research reported here was conducted by the Northeastern Station in cooperation with the Morris Arboretum of the University of Pennsylvania.

[2] Sax, Karl, and Hally Jolivette Sax. Chromosome number and morphology in conifers. Jour. Arnold Arboretum 14: 356-375, 1933.

Cytological Studies in the Theaceae

Frank S. Santamour, Jr.[1]

The best known member of the Theaceae or Tea Family is *Camellia* (*Thea*) *sinensis* (L.) Ktze. which yields the world's most popular drink. Second in repute in this country are the showy, large-flowered camellias of the florist trade. But neither of these plants is native to the Americas. In fact, of the 18 genera of the Theaceae, only a few have representatives that are native to the United States or are even hardy in the cooler temperate regions of this country. The native genera are *Stewartia, Franklinia,* and *Gordonia*. *Camellia* and *Eurya* are exotic genera that can be grown under cultivation in temperate climates. The Morris Arboretum has recently made a concerted effort to obtain specimens of all locally hardy members of these genera because of their distinctive floral and bark features or their botanical value.

Stewartia is represented in the United States by *S. Malacodendron* L. and *S. ovata* (Cav.) Weatherby, both natives of the southern states. *Gordonia* has a single native species, *G. Lasianthus* (L.) Ellis, which grows in the southern Coastal Plain regions. *Franklinia,* named for Benjamin Franklin by the Philadelphia botanist William Bartram, is a monotypic genus represented only by *F. alatamaha* Bartr.

The unusual story of *Franklinia* is well-known, and need only be covered briefly here. This plant apparently occurred over a small area in Georgia near the Altamaha River (then spelled Alatamaha.) It has not been found in the wild since 1790, and all specimens now in cultivation probably trace back to the original tree established in the Bartram Garden at Kingsessing in Philadelphia. The most important point from a taxonomic view is that *F. alatamaha* is placed in the genus *Gordonia* by many authors. The validity of the generic status of *Franklinia* has long been in doubt.

No cytological investigations of the native species of the Theaceae has been made. So the present study was undertaken to determine, by cytological means, the taxonomic affinities of the native plants. In addition, some exotic members

[1] Geneticist, Northeast Forest Experiment Station, Forest Service, U.S. Department of Agriculture. The research reported here was conducted by the Northeastern Station in cooperation with the Morris Arboretum of the University of Pennsylvania, Philadelphia, Pennsylvania.

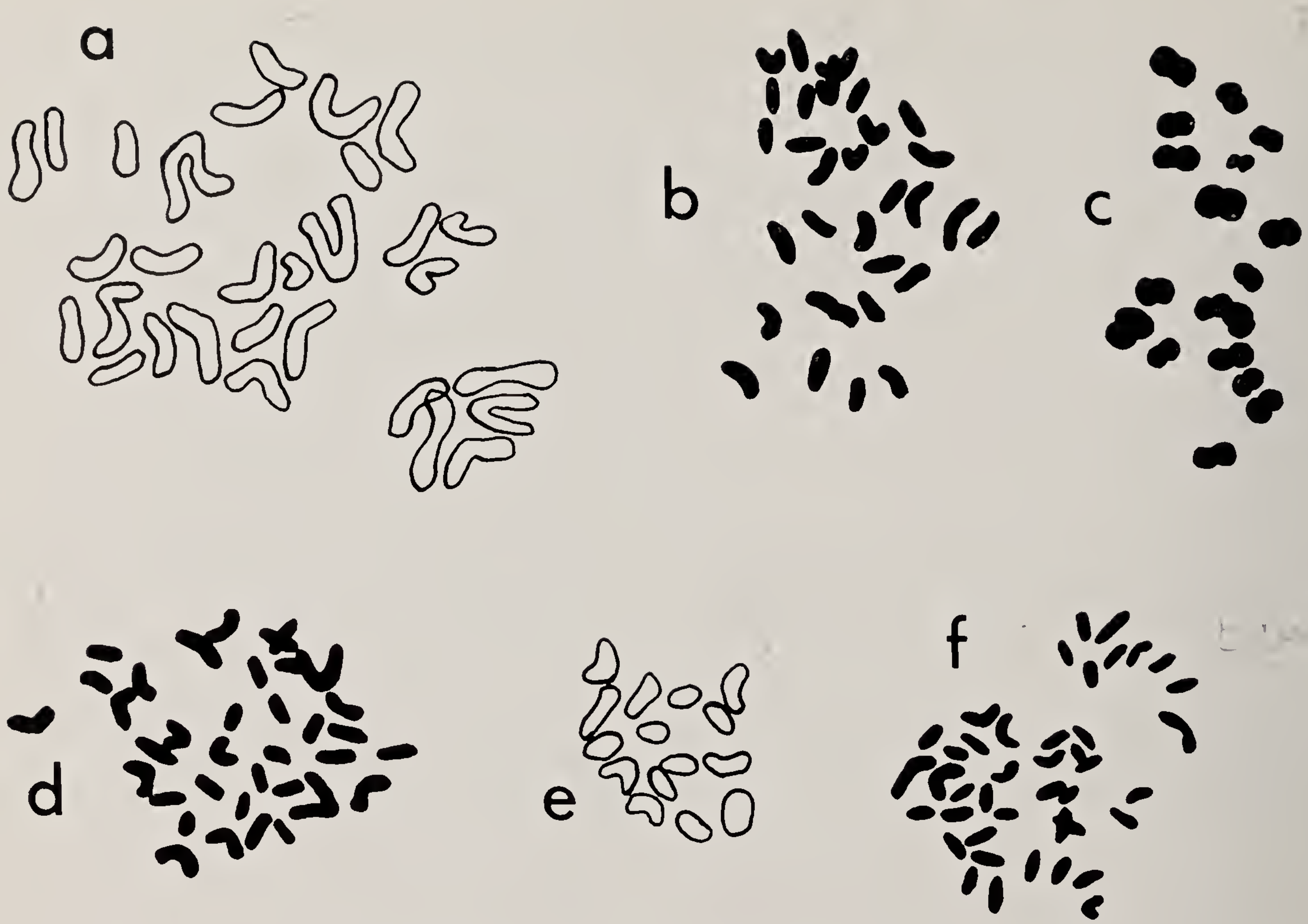

Fig. 26. Relative size of chromosomes (2500 ×) for:
(a) *S. sinensis*, 2n=30; (b) *G. Lasianthus*, 2n=30;
(c) *F. alatamaha*, n=18; (d) *F. alatamaha* 2n=36;
(e) *S. koreana*, n=15; and (f) *E. emarginata*, 2n=42.

of the native or related genera were investigated in order to help evaluate the range of variation within a given genus.

Previous cytological work in the Theaceae had established 2n=30 as the normal diploid number of *Camellia*; some tetraploid and hexaploid species or variaties in this genus have been reported.[2] The diploid number for *Eurya japonica* Thunb. has been counted as 2n=42[3].

Methods and Materials

Somatic chromosome counts were made from mitotic cells of the root tips of established plants or rooted cuttings, and gametic numbers were determined from meiotic pollen mother cells. The root tips were fixed in 1:3 acetic-alcohol plus ferric chloride for 24 hours and then squashed, without maceration, in aceto-carmine. The anthers of closed, immature flowers were handled in the same way. The chromosome counts were made under oil-immersion, and representative plates were drawn at a magnification of 2500 × with the aid of a camera lucida.

Plant material of *Stewartia koreana* Rehd., *S. serrata* Maxim., *S. Pseudo-camellia* Maxim., *S. monadelpha* Sieb. & Zucc., and *Eurya emarginata* Makino was obtained from Mr. Henry Hohman, Kingsville Nurseries, Kingsville, Maryland.

Rooted cuttings of *Gordonia Lasianthus* were received from Mr. E. L. Bennett, Greenbrier Farms Inc., Norfolk, Virginia. The remainder of the plants included in the study were growing on the grounds or in the greenhouses of the Morris Arboretum.

Results and Discussion

The following 7 species of *Stewartia* were found to be diploids with 2n=30: *S. ovata*, *S. Malacodendron*, *S. serrata*, *S. koreana*, *S. Pseudo-camellia*, *S. monadelpha*, and *S. sinensis* Rehd. and Wils. The basic number of X=15 that was found for these species is also characteristic of *Camellia*. The chromosomes of *Stewartia* were the largest of any of the genera included in this study (Fig. 26).

[2] Janaki-Ammal, E. K. Chromosome relationships in cultivated species of *Camellia*. Yearb. Amer. Camellia Soc. pp. 106-114, 1952.

[3] Nakajima, Goichi. Cytological studies in some flowering dioecious plants, with special reference to the sex chromosomes. Cytologia 12: 262-270, 1942.

The diploid number of *Eurya emarginata* was counted as 2n=42, thus confirming the earlier count in this genus.

The most important finding of this study is that *Franklinia* and *Gordonia* can be distinguished as distinct genera on a cytological basis, *G. Lasianthus* is similar to *Stewartia* in having a diploid number of 2n=30, although the chromosomes of the former are considerably smaller. On the other hand, *F. alatamaha* showed counts of n=18 and 2n=36 from meiotic and mitotic plant material.

Different basic chromosome numbers within a genus do occur, but mainly in wide-ranging genera. Because of the paucity of species and limited distribution of *Franklinia* and *Gordonia*, the possibility that both belong to the same genus is considered remote. Thus, it appears that the phenotypic similarities of these two genera serve as a mask to more basic dissimilarities. Based upon cytological evidence, the taxonomic relationship between *Gordonia* and *Franklinia* is probably more distant than between *Gordonia* and *Camellia*.

Arboretum Activities

(*Continued from Page 42*)

blueberries and huckleberries, also contains such useful and attractive genera as *Elliottia, Ledum* (Labrador Tea), *Leiophyllum* (Sand Myrtle), *Kalmia* (Mountain Laurel and Sheep Laurel), *Enkianthus, Pieris, Lyonia, Oxydendrum* (Sourwood), *Leucothoe, Gaultheria, Epigaea* (Trailing Arbutus), *Arctostaphylos* (Bearberry), *Zenobia, Chamaedaphne* (Leatherleaf), and the true heaths and heathers, *Erica* and *Calluna*.

The species and varieties of rhododendrons and azaleas are, of course, so multitudinous as to require extensive sites of their own and these have already been established, the former chiefly along Germantown Avenue and the latter mostly in Azalea Meadow at the foot of the south slope.

The new Heath Garden is being constructed on an acid, well-drained, south-facing slope near the Baxter Memorial, a location previously occupied by a miscellaneous collection of conifers. The ground has been built up and contoured with leaf mold and peat, large boulders have been attractively placed and a winding walk leads the visitor through the collection, down a small flight of steps, and into one of the Arboretum's three Japanese Gardens.

Although, as just noted, the majority of the rhododendrons have their own home, there are numerous small and interesting species which more appropriately belong in the new site where they may been seen to better advantage. These include *R. myrtifolium, R. minus, R. impeditum, R. linearifolium*, etc. A large assortment of varieties of *Calluna* and *Erica* at present in the cold frames will, weather permitting, be placed in the garden this fall or, at the very latest, next spring.

Finally, since nothing so enhances the attractiveness of a garden as running water, a small stream originating farther up the slope is being led over a formation of rocks to empty into a small pool surrounded by box huckleberry (*Gaylussacia brachycera*).

Summer Course

For the ninth successive year the Director, aided by members of the staff, conducted a six weeks graduate course on "Woody Plants" under the auspices of the Summer School of the University of Pennsylvania. Mr. A. Edward Murray, a graduate of Rutgers and the University of Illinois functioned effectively as assistant instructor.

About half of the class of 23 students were high school teachers of biology who were enrolled as participants in the National Science Foundation's Summer Institute. Also in attendance were several graduate students in the University's Division of Landscape Architecture, for whom this is a required course.

Members of the class learned to identify and recognize some 500 species of trees, shrubs and woody vines. This was accomplished by laboratory study, daily walks through the Arboretum, with its rich collection of native and exotic species, and occasional field trips to surrounding areas of botanical interest, including an all-day trip to the New Jersey Pine Barrens.

The students were enabled to make their own herbaria and were given instruction in methods of plant propagation.

J. M. F., Jr.

Winter Damage 1962-1963

UNIVERSITY BOTANICAL GARDEN, CAMBRIDGE

P. T. ORRISS[1]

The British winter of 1962-3 was the worst for many years, and Cambridge suffered its due share of unpleasantness! January and February were the most severe months, when the temperature fell below 10° F. On many occasions, the lowest recorded being 3° F. The following are brief notes on some of the more interesting features of the damage recorded to plants in the Garden.

CONIFERS

The majority of our Conifers came through the winter of 1962-3 reasonably well. No losses of any species of *Pinus* have been recorded, although *Pinus pinea* was badly scorched, as were *P. Armandii* and *P. Griffithii* 'Nana'; these are now growing away quite well. The only total losses were three young plants (about 6 years old) of *Cupressocyparis* × *Leylandii,* and one specimen, about 10 years old, of *Cupressus macrocarpa.* Many of the Lawson Cypresses were damaged in varying degrees, and the scorching of *Sequoia sempervirens, Libocedrus decurrens,* and *Cryptomeria japonica* was severe. The damage to *Cupressus sempervirens* was not nearly so heavy as was expected, while *Cupressus arizonica* was quite undamaged.

[1] This account, for which we are indebted to Dr. John S. L. Gilmour, arrived too late for inclusion in our June issue.

BROAD-LEAVED EVERGREENS

Here again, very few losses were reported, though the amount of damage done through wind-scorch has been considerable. The most notable casualty is one of the commonest plants in English gardens, the Rosemary, *Rosmarinus officinalis;* all our specimens, planted in various parts of the Garden, were killed, with one exception. *Laurus nobilis,* another old English plant, has been severely damaged, and, in one or two cases, may have to be cut down to ground level, as was done after the winter of 1947. The evergreen oaks, such as *Quercus suber* and *Q. Ilex,* were also badly scorched. *Azara microphylla* was killed, as was *Arbutus Unedo* 'Rubra'; the type *Arbutus Unedo,* however, may just recover, but it will never make a good specimen again. Of the Barberries, only *Berberis Darwinii* seems to have suffered, but *Viburnum Tinus* was scorched very badly. The evergreen cherries, *Prunus Laurocerasus* and *P. lusitanica,* were hardly touched, but *Lonicera nitida* was heavily browned, though not so severely as in 1947.

DECIDUOUS PLANTS

These suffered much less than the evergreens, although many species of *Cotoneaster* have died back. No damage is reported on *Rosa* species or garden varieties.

Book Reviews

WOODY FLORA OF TAIWAN. Hui-Lin Li. Livingston Publishing Company, Narberth Pa., 1963. 975 pages, 371 illus. $18.75.

The Morris Arboretum and the Livingston Publishing Company can deservedly take pride in this latest product of their collaboration. The distinguished and scholarly work of Dr. Li, on the woody flora of the island better known until recently as Formosa, is here presented to the public in a dignified, yet easy to use format. The public, in this case, is a highly selected one, composed in large measure of trained botanists and in particular, those interested in the flora of what we call the Far East. On the other hand, it is a book which should find a place in every library that caters to serious botanists: university libraries, particularly those of the biology departments; large city libraries, museums, botanical gardens, arboreta, both in the United States and in all large centers of learning over the world; in all of these Dr. Li's guide has an undeniable place.

While the greater part of the weighty volume is devoted to a systematic study of the woody plants of Taiwan, the introductory section provides interesting related material, and a selected bibliography lists the most important references used in preparation of the work. A preliminary chapter discusses the physical background of Taiwan: its location, topography, soils, and climate. This is followed by a detailed analysis of the vegetation and its floristic composition; first in terms of altitudinal distribution, then by families represented, and finally by geographical areas of the world with which the plants are related. It is this section which can well be studied by every professional botanist, and certainly also by the serious amateur, many of whom, of course, are included among the Associates of the Morris Arboretum.

The main body of the work provides first a key to families, in an arrangement which some will find new, since the monocotyledons follow the dicotyledons. In the latter we end with the

Goodeniaceae, rather than with the usual Compositae (which are not represented in the woody flora here described). The monocotyledons begin with the Pandanaceae and close with the Liliaceae. Keys to genera and species are included, and descriptions of each species include distributional data and complete synonymies. The illustrations, of one species in practically every genus, merit special commendation. They are beautifully executed line drawings, by a Taiwanese artist, C. T. Chen.

Another Taiwanese botanist, Dr. James Chen, has been kind enough to permit me to pass on an observation of his in this review. As Dr. Li mentions in his introduction, the names of localities in Taiwan have long been in a confused state, due to occupation of the island for so long by various groups. For this reason, he has attempted to cite all the names (with a few exceptions) as they will be found on current Chinese maps. This, says Dr. Chen, was an enormously difficult task. To reduce the native aboriginal names reported by many collectors, as well as the Japanese names and the older Chinese names, to those in modern usage, required the most painstaking kind of work, and for this botanists using the work will be most grateful since they can now, in most cases, turn to modern Chinese maps and locate the collection sites for a particular species.

Dr. Li, who has been on the staff of the Arboretum for a number of years, is noted in his field as a skillful, meticulously careful, and perceptive taxonomist. His many publications which include several books, as well as numerous articles in various botanical journals, have always been regarded most highly by his colleagues. This latest publication adds fresh luster to an already illustrious name.

Ida K. Langman

The Origin and Cultivation of Shade and Ornamental Trees. Hui-Lin Li. University of Pennsylvania Press, Philadelphia, Pa. 282 pages, 90 illus. 1963. $6.00.

Of the making of books about trees there is apparently no end and this is entirely as it should be, for trees are among man's best friends and most valued possessions. Dealing, as the present volume does, with shade and ornamental trees, it constitutes an significant contribution to a literature which is heavily overweighted with works on trees as sources of fruit, fiber, drugs or timber.

Dr. Li, taxonomist at the Morris Arboretum, and no stranger to these pages, has long been a careful student of the flora of the northern hemisphere. His intimate knowledge of the flora of southeastern Asia, a region which has contributed so many woody plants to eastern American horticulture, qualifies him eminently to write about those kinds of trees which not only delight the eye but provide grateful shelter and shade to persons living in temperate North America.

In an introductory chapter the author deals with man's early knowledge of the value of trees, their geographic distribution, their modes of cultivation, and their capacities for selection and improvement. Sections devoted to the dispersion of cultivated trees and recent botanical exploration prepare the reader for the detailed descriptions of individual genera which follow.

The treatment of weeping willow, Lombardy poplar, plane tree, ginkgo, horse chestnuts, lindens, maples, locusts and dawn redwood have appeared previously in these pages of the Morris Arboretum Bulletin. The author has added chapters on Conifers, Ornamental Flowering Trees and other important genera of Shade Trees, the last-named containing brief discussions of *Fraxinus, Betula, Quercus, Fagus,* etc.

Separate chapters contain lists of tree species which originated in Europe and Western to Central Asia, in Eastern Asia, and in North America. In each of these three geographic categories a special section is devoted to a brief consideration of those tree genera which are endemic.

The book closes with a very useful bibliography and indices to both scientific to common names of trees.

Dr. Li has assembled between the covers of this modest volume a tremendous amount of valuable information concerning a group of plants without which our parks, gardens, cities, and highways would be bleak places indeed.

J. M. F., Jr.

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since June, 1963

Mrs. Wm. E. Almy

Mrs. Madeleine Costigan

Mrs. Edgar L. Eckfeldt

Mr. M. D. Fisher

Sister Edward Anita

Mrs. M. S. Gelbach

Mr. John Gill

Mr. Arnold Gorneau

Mr. Warren M. Gruber

Miss Ruth B. Harris

Mr. Albert N. Hoxie, 3rd

Mrs. Samuel M. Keck

Mr. Edward H. Kuljian

Mr. A. Edward Murray, Jr.

Mr. Charles A. Olson

Mrs. Richard L. Philson

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Tsuga caroliniana

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
Sustaining	$10.00 a year	Sponsoring	$100.00 a year

Donor $500.00

Arboretum Activities

THE STAFF

On Wednesday, October 9, the Director spoke to the Eighth Symposium on Pennsylvania Gardens at Strawberry Mansion on the topic "Gardens of Useful Plants." From October 10 to 13 he attended the joint meetings of the American Horticultural Society and the American Association of Botanical Gardens and Arboretums which were held in St. Louis. At the sessions of the former he gave an illustrated lecture on, "What's New in Magnolia" and before the AABGA he spoke on "Special Collections at the Morris Arboretum." On Saturday, October 19, Dr. Fogg participated in the Autumn Garden Day of the Pennsylvania Horticultural Society at Ambler Junior College; his subject was "Magnolias." On October 23 he spoke to the Garden Club of Springfield on the "Flora of Pennsylvania" and on October 30 he delivered a lecture before the graduate seminar in Botany at Rutgers University on "Some Floristic Problems of the Philadelphia area." At a meeting of the Philadelphia Chapter of the American College of Dentists, held at the U. of P. Faculty Club on

(Continued on Page 65)

Tsuga at the Morris Arboretum

John M. Fogg, Jr.

The genus *Tsuga,* commonly known as Hemlock, is a member of the Pinaceae or Pine Family. It is generally regarded as including about ten species of evergreen trees, two of them native to eastern Canada, New England and the Appalachian Plateau, two indigenous to the Cordilleras from Alaska to California, and the remainder found in eastern and southern Asia from Taiwan and Japan, across China to the Himalayas. The genus is totally unrepresented in Europe or the southern hemisphere.

The origin of the word "hemlock" is somewhat obscure. According to Webster's New World Dictionary it is derived, through Anglo-Saxon, from two Middle English words signifying "hop" (*Humulus*) and "leek", any one of several garden herbs. Certainly in one of its earliest applications the name referred to *Conium maculatum,* the poison hemlock, of Europe. It has been suggested that the graceful sprays of the American hemlock reminded the early colonists of the dissected foliage of the poison hemlock and led to the application of the common name to our trees.

Hemlocks seem to thrive best in situations where soil and atmospheric conditions are moist. Doubtless this is why in our area they are usually found growing on cool north-facing slopes.

Nomenclatural History

The use of *Tsuga* as a generic name is of comparatively recent origin. In the first edition of his Species Plantarum (1753), Linnaeus described *Pinus balsamea,* a name which is regarded as having included both *Tsuga canadensis* and *Abies balsamea.* In his second edition (1763), the former appears as *Pinus canadensis.* In his Flora of North America (1803), Michaux transferred *P. canadensis* to *Abies,* the genus of the fir or balsam. It is of interest to note that for many years the hemlock was referred to as hemlock fir. In fact, this name may still be met with, e.g., Bean (1951).

The hemlock was also at one time (Link 1841) placed in *Picea,* the genus of the spruce. This led to its popular designation as hemlock spruce, a name which seems no longer to be in use.

In 1855 Carrière recognized the hemlock as a separate genus and assigned it to *Tsuga,* a name which had been used by Endlicher (1847) for a subdivision of *Pinus.* The name *Tsuga* is of Japanese origin.

Characters of the Genus

The hemlock is so well known that no detailed description of it seems necessary. The leaves (needles) are spirally arranged and usually two-ranked (biplanate), although in one of our species (*T. Mertensiana*) they are radially disposed.

Tsuga is the only genus in the Pinaceae in which the leaves are borne on a distinct petiole; a slender stalk which is 1 to 2 mm. in length. The leaf-blades are flattish, generally with a groove or furrow on the upper surface. However, in one species (*T. Mertensiana*) the upper surface of the leaf is rounded or even slightly ridged. Lines of stomata may appear as either faint or distinct white bands on the lower, or occasionally also on the upper, surface of the leaf. The apex of the leaf may be either obtuse and rounded or notched (emarginate).

The two kinds of "flowers" of the hemlock are borne on the same tree; the male solitary, axillary and globose, the female terminal on lateral branchlets. The cone is ovoid or cylindrical ¾ to 3 inches (1.5 to 7.5 cm.) long, and made up of overlapping concave woody scales which usually conceal the bracts. The seeds are winged.

The Hemlock Arboretum

Undoubtedly the most distinguished collection of hemlocks ever assembled in one place was that of the late Charles F. Jenkins of Philadelphia. Mr. Jenkin's arboretum which was known as Far Country was established about 1930 on the grounds of his home near Kitchen's Lane in Mt. Airy, Philadelphia. At the time of his death in 1951 this collection included all the species of *Tsuga* known to be hardy in this area, as well as a large number of varieties. In *T. canadensis* alone Swartley (1939) states that the collection contained more than 40 variants.

From 1932 to 1950 Mr. Jenkins published a series of bulletins entitled "The Hemlock Arboretum". These contained a wealth of information about hemlocks as well as other plants.

Mr. Jenkins was extremely generous to the Morris Arboretum and several of our most interesting specimens were presented by him.

Fig. 27 *Tsuga Sieboldii*

KEY TO SPECIES

In the following key primary emphasis is placed upon the leaves. Good characters are also present in the cones, but these are not always available for purposes of identification.

1. Leaves rounded or keeled above, spreading radially with whitish (stomatiferous) bands on both surfaces; cones 4-7 cm. long *T. Mertensiana*
1. Leaves flat, grooved above, in two ranks, with whitish (stomatiferous) bands on under surfaces; cones 1.5-3.5 cm. long.
    2. Leaves distinctly notched at the apex
        3. Branchlets glabrous; leaves 5-15 mm. long .... *T. Sieboldii*
        3. Branchlets pubescent
            4. Leaves 4-12 mm. long, 1-2 mm. wide *T. diversifolia*
            4. Leaves 10-20 mm. long, 2-3 mm. wide *T. chinensis*
    2. Leaves entire or only indistinctly notched at the apex
        5. Margins of leaves entire; leaves 10-18 mm. long; cones 2.5-3.5 cm. long *T. caroliniana*
        5. Margins of leaves minutely denticulate, at least toward the apex; leaves 6-12 mm. long; cones 2-2.5 cm. long.
            6. Leaves of uniform width throughout, whitish bands on lower surface ill-defined, denticulations obscure *T. heterophylla*
            6. Leaves usually tapering slightly from the base to the apex, whitish bands on lower surface evident, denticulations conspicuous ..... *T. canadensis*

T. Mertensiana (Bong.) Carr. (*T. Hookeriana* Carr., *T. Pattoniana* Sènècl.) Mountain Hemlock, Black Hemlock.

The leaves of this species differ from those of other hemlocks in being rounded or keeled on the upper surface instead of flat or grooved. Also, the leaves are radially disposed, while those of the other species are usually somewhat two-ranked. Another distinction is that there are whitish lines of stomata upon both surfaces instead of merely the under side of the leaf. The cones of this species vary from 1½ to nearly 3 inches (4 to 7.5 cm.) in length, whereas in no other species do they exceed 1½ inches (4 cm.)

Mountain hemlock is a handsome tree up to 160 ft. (about 50 m.) in height, which ranges from Southern Alaska south through the Olympic and Cascade Mts. and the Sierra Nevadas to Kings River, California, and eastward to the Selkirks, northern Idaho and western Montana (Abrams 1923). According to Munz (1959) it is found between 6,000 and 11,000 ft. The label on a specimen from Oregon in our Herbarium states that its associates were *T. heterophylla, Chamaecyparis nootkatensis, Abies amabilis,* and *Pinus monticola.*

Two specimens of *T. Mertensiana* were presented to us several years ago by the Director of the Westtown School Arboretum, Dr. Albert F. Bailey, Jr., who obtained them from a collector in Oregon. Unfortunately these did not

Fig. 28 *Tsuga diversifolia*

Fig. 29 *Tsuga chinensis*

survive the severe winter of 1962-63. We are happy to report, however, that thanks to the kindness of Mr. Fred Bergman, of Feasterville, Pa., we have recently received another young plant of this species. It has been placed west of the Lodge, along Hillcrest Avenue, not far from a thriving specimen of *T. heterophylla,* the other hemlock indigenous to western North America.

A hybrid between *T. Mertensiana* and *T. heterophylla,* known as *T. Jeffreyi* (Henry) Henry, was discovered more than a century ago in British Columbia. According to Dallimore and Jackson (1948), it is intermediate in character between the two supposed parents, both of which occur in the same area. So far as we are aware, this hybrid is not in cultivation in the Philadelphia area.

T. Sieboldii Carr. (*T. Araragi* (Sieb.) Koehne.) Siebold Hemlock, Southern Japanese Hemlock.

The light brown, polished, glabrous branchlets of this species separate it from all other hemlocks grown in this area. The glossy green leaves vary from 5 to 15 mm. in length, are approximately 2 mm. wide, are distinctly emarginate at the apex and, when fresh, show two clear white bands on the lower surface. The ovoid cones are about 2 cm. long.

T. Sieboldii, a species of southern Japan, (S. Honshu, Shikoku and Kyushu) is in its native haunts a tree up to 100 feet (30 m.) with horizontally spreading branches. In cultivation it is slow-growing and often more shrub-like in habit.

Of half a dozen specimens at the Arboretum the largest is situated on the slope along Hillcrest Avenue, just east of the Japanese Garden (Fig. 27)[1]. Another fine plant is located along the upper roadway, near the corner of Hillcrest and Germantown Avenues. Others are to be found on the south slope near the Azalea Meadow.

T. diversifolia (Maxim.) Masters (*T. Sieboldii* var. *nana* Carr.) Northern Japanese Hemlock.

The reddish brown, densely pubescent branchlets of this species serve to distinguish it from *T. Sieboldii,* which it somewhat resembles and of which it was formerly considered a variety. Also, the leaves are significantly shorter than those of the preceding species and are also appreciably narrower, being only 1 to 2 mm. in width instead of 2 to 2.5 mm. It is worthy of note that the needles of *T. diversifolia* are the shortest of any hemlock, with the possible exception of certain minute-leaved variants of *T. canadensis* (e.g., var. *microphylla*). From the latter species it may, of course, be differentiated by the emarginate apex of its leaves. In our material the branches are more ascending than those of *T. Sieboldii,* resulting in a tree which instead of being flat-topped, is conical and tapering. (Fig 28).

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[1] Cover illustration and Fig. 27-32 and 34-35 by Miss Dorothy G. Baldwin. Fig. 33 by Dr. Patricia Allison.

Fig. 30 Leaves of *Tsuga caroliniana*

Fig. 31 *Tsuga caroliniana*

T. diversifolia occurs in the central and northern portions of Japan where it is said to attain a height of 70 to 80 feet (25 m.). Sargent (1894) notes that the great forest which covers the Nikko Mts. at an altitude of more than 5000 ft. is composed almost entirely of this species. He adds that it is distinguished by its bright red bark, small leaves and small cones.

Our finest plant of *T. diversifolia* is also to be found along Hillcrest Avenue, not far from the large *Sieboldii*. It is about 25 feet tall and was acquired from Cos Cob in 1935. The species grows extremely well in this area and deserves to be more widely planted.

T. chinensis (Franch.) Pritz. Chinese Hemlock.

Like the preceding species, the Chinese hemlock has pubescent branchlets. Here, however, the hairiness is usually confined to the grooves of the yellowish-gray twigs. The leaves are the largest of any species hardy in this area attaining a length of 20 mm. and a width of 3 mm. Rehder (1940) gives the upper limit as 25 mm. in length, but this does not occur in our material.

T. chinensis was first described from Szechuan province in western China, whence it was introduced about 1900. Today it is also known from the central and eastern provinces. In the wild it is a tall symmetrical tree, attaining a height of at least 100 ft. (30 m.). More frequently it is said to occur as a "smaller, densely pyramidal tree" (Dallimore and Jackson 1948).

Our single specimen, which is located near the other Oriental species along Hillcrest Avenue, is a narrow graceful tree, with long slender branches which droop somewhat at the tips. (Fig. 29). It was obtained from the late Mr. Charles F. Jenkins in 1948.

The following three Asiatic species are not in cultivation either at the Arboretum nor, so far as we are aware, elsewhere in this area.

T. dumosa (D. Don) Eichl. (*T. Brunoniana* Carr.) A native of the Himalayas. According to Stainton (1963), who observed it at about 9000 ft., "This is the most attractive of the Nepal conifers". Bean (1951) states that it is adapted only for the milder parts of the British Isles and Rehder (1940) lists it as doubtfully hardy in Zone VII.

T. formosana Hayata. This species was originally described by Hayata from a specimen collected in Formosa (Taiwan). Li and Keng (1954) later reduced to a varietal status under *T. chinensis*. (See also Li 1963).

T. yunnanensis (Franch.) Masters. This species, which is related to *T. chinensis*, is native to western China whence it was introduced into the Arnold Arboretum in 1908. Rehder lists it as questionably hardy in Zone VI and it is not believed to be in cultivation in the Philadelphia area.

T. caroliniana Engelm. Carolina Hemlock.

Although most authors state that this and the following two species possess the same range of variation in leaf length (6 (8) to 18 mm.), this is certainly not borne out in our material. Even to the casual observer, *T. caroliniana* stands apart not only from these two, but from most other hemlocks, by virtue of its long, slender needles. An extensive series of measurements made on our specimens reveals that the leaves of *T. caroliniana* are frequently 17 or 18 mm. long and are seldom shorter than 10 mm. Also the leaves of this species are more remotely spaced than those of our other species, giving the branches a somewhat delicate, graceful appearance (Fig. 30). The short stalked cones which are 2-3.5 cm. long are exceeded in length only by those of *T. Mertensiana*.

Carolina hemlock is a handsome tree of the southern Appalachian Mts. from West Virginia to Georgia. It may attain a height 70 or 80 ft. (25 m.). With us it is perfectly hardy, but rather slow-growing and of somewhat compact, columnar habit (Cover and Fig. 31). Two small specimens are located at the edge of the woods on the south slope above the Rose Gardens; one may be seen along Hillcrest Avenue; two others are in the Bloomfield nursery.

T. heterophylla (Raf.) Sarg. (*T. Albertiana* (A. Murr.) Sénècl., *T. Mertensiana* of some authors, not (Bong.) Carr.) Western Hemlock.

Although, as noted under the foregoing species. authors accord the leaves of *T. heterophylla* and *T. canadensis* a length of 18 mm., ours are noticeably shorter, seldom being more than 12 mm. long and usually less. Another feature which is generally stressed under these two species is the denticulate or minutely serrulate margin of the leaf. In *T. heterophylla* this character is frequently obscure. The margins of many of the leaves seem to be entire and even those which are denticulate may reveal this condition only toward the very tip. A lens of at least 10 diameters magnification is needed in order to bring out this character.

Fig. 32 *Tsuga heterophylla*

As stated in the key, the leaves of western hemlock have parallel margins in contrast to those of *T. canadensis* which taper very slightly from the base to the apex. Also the stomatiferous lines on the under leaf surface of the present species are not conspicuous and the green-marginal bands are rather indistinct, in contrast to those of *T. canadensis,* which are usually very striking. Occasionally small leaves arise from the branchlet at an angle to the larger two-ranked leaves, imparting to the twig a "brushy" appearance.

Western hemlock is a huge forest tree, up to 200 ft. or more (70 m.), which extends from Southern Alaska to Mendocino County, California and east through southern British Columbia and Washington to the Bitter-root Mts. of Montana and the west slope of the Cascades in Oregon (Abrams 1923). Although both Bailey (1928) and Rehder (1940) state that this species does not grow well in the climate of the eastern states, our three specimens have made slow but satisfactory growth; all of them are from seedlings collected in Alaska. The one near the Lodge, along Hillcrest Avenue although badly shaded by nearby deciduous species has attained a height of 20 ft. in about 25 years and is of a slender conical habit (Fig. 32).

This plant which was obtained from the Jenkins Arboretum, for many years bore the label "*T. Mertensiana.*" It is of interest in this connection to note Bailey's (1928) comment that, "*T. heterophylla* was known for a long time as *T. Mertensiana* and still bears this name in many gardens." This statement is repeated almost verbatim by Rehder (1940).

T. canadensis (L.) Carr. (*T. americana* (Mill.) Farw.) Canada Hemlock. Eastern Hemlock.

In contrast to *T. heterophylla,* the leaf-margins of Canada hemlock are usually conspicuously denticulate, especially above the middle. However, this is a variable character, one which requires careful examination with a lens. As already noted, there is some difference of opinion concerning the length of the leaf in this species. Swartley (1939), who studied this matter carefully, concludes that, although the leaves may vary from 4-16 mm., 7-9 mm. is a fair range for the average length. Reference has also been made above to the conspicuous white bands, flanked by green marginal bands, which differentiate the under-leaf surface of this species from that of *T. heterophylla.* In common with *T. heterophylla,* the branchlets of Canada hemlock usually produce short "accessory" leaves. In *T. canaden-*

Fig. 33 *Tsuga canadensis* var. *albo-spica*

sis, however, these leaves instead of merely being directed forward are actually flattened against the branchlet, thus constituting one of the best characters for recognizing this species.

Canada hemlock is a wide-ranging species which occurs from Nova Scotia and New Brunswick to Maryland and eastern Minnesota and south along the mountains to northern Georgia and northern Alabama (Fernald 1950). It is not only an important tree in the lowland portions of our northern coniferous forest, but is essentially the only gymnosperm found in the eastern deciduous woodlands, where it is usually restricted to well-drained and often north- or west-facing slopes.

Old trees frequently attain a height of 100 ft. (30 m.), but today one must visit a reservation such as Heart's Content or Cook Forest State Park, in Pennsylvania, in order to see specimens of real magnitude.

The Arboretum is fortunate in having a wooded slope along the Wissahickon Creek where native hemlock is mixed with beech, chestnut oak and black birch.

Of all the species of hemlock, *T. canadensis* has shown the greatest tendency to vary both in the wild and in cultivation. These variations have led to the application of a large number of subspecific names. Some of these have been discovered in the wild and may be designated as botanical varieties, others are known only in cultivation and are today more correctly considered to be cultivars.[1]

The most penetrating and comprehensive study of the variations of *T. canadensis* is that of Dr. John C. Swartley (1939). In this monograph Swartley recognizes 24 varieties and several forms. Since the concept of the cultivar had not come into general use at the time this study was made, it is not always possible to determine the status of many of Swartley's names. Moreover, the last few years have witnessed a phenomenal increase in the number of cultivar names, most of them emanating from growers who are catering to the tremendous popular demand for bizarre and low-growing conifers. Someone has estimated that over 100 such names have been given to variants of *T. canadensis* alone.

It is not the intention in the present account to deal with the multiplicity of variants, of which the Arboretum has a goodly series. Such a treatment must await a clearer understanding of their relationships. We shall therefore, content ourselves with the mention and brief characterization of five familiar varieties which represent well defined extremes and seem to be worthy of recognition. Since it is not yet possible to determine which of these are botanical varieties and

[1] See Fogg, Variety versus Cultivar. Morris Arb. Bull. 12: 17. 1961.

Fig. 34 *Tsuga canadensis* var. *nana*

Fig. 35 *Tsuga canadensis* var. *pendula*

which are cultivars, and since no official list of registered cultivar names in *Tsuga* has as yet been published, the following are treated as though they were varieties.

Albo-spica. Tips of young branchlets creamy white. A fine specimen of this beautiful variety is to be found just east of the Lodge along Hillcrest Avenue. (Fig. 33).

Macrophylla. Leaves larger than the type, average more than 10 mm. By some students this is interpreted as including var. *atrovirens.* The Arboretum has several specimens, of which the largest is planted in the triangle between two roadways west of the Lodge.

Microphylla. Leaves very small, average length less than 6 mm. A very slow-growing form. Swartley considers that vars. *gracilis* and *Jenkinsii* belong here. Our finest plant is near the Log Cabin. Another good one labeled "Bristol Variety" is located just north of the Rose Garden.

Nana. A dwarf, depressed variety. Two specimens may be seen just east of the Lodge (Fig. 34). These have been identified by Dr. Swartley, who gave them to us, as plants of a low spreading clone which originated at the Curtis Nurseries at Callicoon, N. Y.

Pendula. Sargent Weeping Hemlock. A flat-topped form with spreading and drooping branches. There appears to be some question as to whether the various tall weeping hemlocks seen in cultivation are the product of grafting or whether they have been staked and trained. Without doubt our two specimens are the result of the latter. One is just inside the main gate on Meadowbrook Avenue; the other is on the south bank of the Swan Pond. (Fig. 35).

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Arboretum Activities

(Continued from Page 58)

November 13, he gave an illustrated talk on "The Search for New Remedies in Burma and Thailand."

Dr. Li gave an illustrated lecture to the Twin Creek Garden Club on Wednesday, November 6. His topic was "Japanese Gardens."

On October 2 Dr. Allison spoke to the Science Research Club of the Plymouth-Whitemarsh High School on the subject "The Fungi as Potential Research Organisms."

Charles J. Seltzer, Jr.

It is with deep sorrow and a profound sense of loss that we record the death on November 12, of Mr. Charles J. Seltzer, Jr., of Rose Valley, Pa. Mr. Seltzer had been a member of our Advisory Board of Managers since 1956. His wonderful capacity for friendship and his never-failing good humor will be sorely missed by all of us who enjoyed the rare privilege of being associated with him.

Forestry Group Departs

For nearly twenty years the Forest Genetics Project of the Northeastern Forest Experiment Station has been located at the Morris Arboretum. On September 1, by order of the U. S. Forest Service, this group was shifted to new quarters at the University of New Hampshire in Durham, N. H.

During the two decades that they enjoyed our hospitality the members of this team made full use of the facilities of the Arboretum: its library, herbarium, greenhouses, nurseries and living collections. Some of their basic work on the hybridization of poplars and conifers was conducted here.

We, on our part, profited greatly by the presence of this group in our midst. We often consulted them on problems that lay beyond the competence of members of our own staff. Their chief, Dr. Ernst J. Schreiner, and his associates, Dr. Jonathan W. Wright and Dr. Frank J. Santamour, Jr., were frequent contributors to this Bulletin.

We are sorry to see them leave and wish them the best of luck in their new home.

Visit of Dendrologists

On October 10th thirteen members of the International Dendrological Union visited the Arboretum as part of their eighteen day tour of the eastern United States.

The party arrived at 11 A.M., after having first stopped to inspect the Arboretum of the Barnes Foundation at Merion. After wandering for an hour and a half about our grounds the members of the group were served luncheon on the porch of the Gates Building. From here they left to visit the gardens of Mrs. J. Norman Henry at Gladwyne. The group included:

The Duke & Duchess of Abercorn
Mr. & Mrs. Robert de Belder, Kalmthout Arboretum, Antwerp, Belgium
Dr. & Mrs. Clement G. Bowers, Maine, N. Y.
Baron & Baroness Paul de Favereau de Jeneret, Beligum
Mr. Harold Hillier, Jermyns, Romsey, England
Dr. S. Y. Hu, Arnold Arboretum, Mass.
Mr. & Mrs. Robert Lenoir, Brussels, Belgium
Lord Talbot de Malahide
Mrs. Mary Williams, Penzance, England

Fall Planting

Although, as has frequently been mentioned in this department, fall is usually our busiest time for transplanting, the autumn of 1963 was a notable exception. This was, of course, due to the almost total lack of rainfall. The precipitation for October was less than a tenth of an inch, which equaled a record of many year's standing. The result was an almost unprecedented baking of the soil in the nurseries and on the grounds, making it impossible to dig and move plants.

Since conditions were not propitious for moving plants in October, attention was directed toward a vigorous "house-cleaning." The most ambitious undertaking was the complete renovation of the south-facing slope extending from below the Rose Garden down to the wooden steps leading up to the Phlox Garden. This area had become a veritable wilderness of seedling *Philadelphus, Lonicera, Viburnum,* etc. These were removed by tractor and new rich soil was spread over the area. When November arrived, bringing more than 6½ inches of rainfall, we were ready for planting, salvaging what might have been a disastrous situation.

On the portion of this slope nearest the Rose Garden we have established our collection of Stewartias and other members of the Tea Family. A few were already there, but the collection has been greatly augmented. We now have, for example, eighteen plants of *Stewartia,* representing seven species and one variety.

Farther along this same slope we have set out nearly thirty plants of *Vitex,* a really good series of color forms which should make a fine show within a year or two. We have also added substantially to our collection of *Cotoneaster,* in the area of the Seven Arches, so that now nearly 100 plants and about 40 species represent that genus. *Hamamelis* is another group which has been augmented by recent plantings.

In the Bloomfield area, across Northwestern Avenue, additions have been made to such families as Rosaceae (*Chaenomeles, Crataegus, Malus*), Rutaceae (*Ptelea*), Oleaceae (*Fontanesia, Syringa*), and Caprifoliaceae (*Sambucus, Symphoricarpus, Viburnum*).

Recreation Area

From mid April until late October the Recreation Area was the scene of many outings scheduled by students and faculty from the campus of the University. Nearly 4000 persons, representing some 40 organizations, availed themselves of this popular facility. It should be emphasized that when not engaged by University personnel this area may be utilized by other groups who need only request a date through the office of the Dean of Men, 107 Logan Hall.

J. M. F., Jr.

The Butterflies of the Morris Arboretum: 1963

Arthur M. Shapiro

The 1963 season was an unusual one in several respects in the Philadelphia area. The most notable climatological feature of the season was the rainfall deficiency which persisted from April into November, with the single break of importance in September. The drought reached critical proportions in October, when only .09 inch of rain fell in the entire month. The summer and the month of October were warm with a prevalence of southwest winds, but the usual northward influx of southern butterflies was not noted.

Several of the trends begun in 1962 were maintained or progressed in the same direction. *Euptoieta claudia* was uncommon, only three being seen at the Arboretum, one in July and two in October. This represents the worst showing the insect has put up there since its first discovery in 1960. *Precis coenia,* the Buckeye, did not reappear, making it rather certain that the species did not survive the rigorous winters of the last two years. The Checkered Skipper, *Pyrgus communis,* was below normal in numbers but still not uncommon, despite the fact that its food plant, *Abutilon Theophrasti,* was unusually scarce. The Fiery Skipper, *Hylephila phylaeus,* was in normal numbers all season; the last seen was in October 27.

Aside from the southern species, a few of the endemic ones seemed to have suffered a severe setback, possibly in consequence of the abnormally severe winter. *Lethe eurydice* was one of these; only four were seen. *Melitaea nycteis* was completely absent from the Arboretum, but was taken in almost normal numbers near Horsham, Pa. All of the *Limenitis* were extremely scarce throughout the metropolitan area. No *archippus* at all were seen at the Arboretum, and only two *astyanax*. *Papilio polyxenes* reached the lowest population size the writer has ever seen. One male was seen at the Arboretum (July), and only twelve in the entire metropolitan area all season. *Pieris protodice* did not appear at the Arboretum until late September, but was common in mid and late October, eight being seen (three taken) . The fluctuations in these mostly stable, conservative species are difficult to explain on the basis of intrinsic population cycles, and one must search for explanations in the abnormal weather. The sudden drop in *Limenitis astyanax* was especially striking since that species had just managed to restore normal population levels in 1962 after a long slump. *Polygonia* decreased slightly in 1963, but this was expected following the peak of abundance of these cyclical insects in 1962. One *P. progne* was taken in the woods in area 4, September 7.

On the plus side, the reappearance of *Vanessa cardui* may be reported. The circumstances of this development are rather interesting. The insect had decreased from a large population in 1958 through a steady decline to complete absence in 1962. In June of 1963 several were seen, but not captured, in the Arboretum and the Mt. St. Joseph tract across Stenton Avenue. Finally, on June 21, one was taken for confirmation. It proved to be the largest individual the writer has ever seen of this species, the forewing measuring 37 mm. from base to apex. The mean for 39 1958-61 specimens from Philadelphia is 31 mm., and for 11 from Albuquerque, New Mexico, 25 mm. This individual is a female of the richly colored form *"jacksoni"*. Nine more individuals were seen at the Arboretum during the remainder of the season, none appearing exceptionally large, and two were seen in Cheltenham Township, Pa., one in July and one in late September. It is to be hoped that the resurgence will continue, and it will be of considerable interest to see whether the "new" population will be genetically any different from the "old" one. The reappearance of the insect was undoubtedly based on migration into the area from without. A worn male was seen as late as November 10.

Vanessa atalanta was as common as in 1961, but it is somewhat periodic and the increase in numbers may not be correlated with environmental conditions such as the drought. *V. virginiensis* was unusually common well into October. The last of the season was taken October 27, a full 14 days later than the latest previous area record. The late fall specimens were perhaps the most extreme of the "dry weather" form the writer has taken since 1955. *Nymphalis antiopa* hibernators were very numerous in the spring and remained at the high levels of the previous year through most of the season. Two were seen in August in area 3, and none thereafter.

Strymon melinus was the only Hairstreak to be below normal in numbers in 1963, but it was not really rare. *S. caryaevorus* was taken in small numbers (5) in 1963 in Chestnut Hill but still is not recorded from the Arboretum. *Feniseca tarquinius* and *Lycaenathoe* were not seen. *Lycaenopsis argiolus* was very numerous in April and May in area 3. The "*marginata*" individuals were larger than usual and made up a larger proportion of the brood than is generally the case. This phenomenon is probably attributable to the cold winter of 1962-63.

The Swallowtails were normal except for *polyxenes*. One male *philenor* was seen in Chestnut Hill, but neither *philenor* nor *marcellus* turned up at the Arboretum. *Anthocharis genutia,* the Falcate Orange Tip, was rather numerous along the Wissahickon in April and also at Mill Grove, Montgomery Co. The species of *Colias* were abundant, as usual. The season was unusual, however, in that a new mutation was discovered in the mixed *C. philodice-eurytheme* population on the Mt. St. Joseph grounds, across Stenton Avenue. No mutants were taken in the Arboretum. Genetic research on this character is in progress. Its visible manifestation takes the form of a single, rather than a double, ring around the hind wing discocellular spot.

Skippers were generally normal, with *Erynnis brizo* more common than usual in the area, and one taken in the Arboretum. *H. sassacus, A. vialis,* and *P. ocola* were the only listed Hesperiidae not taken this year. One *Erynnis horatius* was taken July 27 on *Apocynum cannabinum* in area 4. This was the first Arboretum record of *Erynnis* in other than April, May, or the first week of June. *E. horatius* has been taken into September in Philadelphia.

Along with *E. brizo,* two other new species of Skippers were recorded from the Arboretum. The three descriptions follow, in the format of the previous articles.

Erynnis brizo, Sleepy Dusky Wing (222)

One specimen, June 1, 1963, in the woods in area 3. The species is fairly common in Philadelphia and Cheltenham Twp., from May to early July, but had not been taken previously at the Arboretum.

Wallengrenia otho, Broken Dash (248)

This is generally a common insect in the Philadelphia area, but was not seen at the Arboretum until June, 1963, when nine were taken in the Medicinal Garden on various blossoms. It is possible that the species was previously present but overlooked because of its small size and inconspicuousness. It is very abundant in Cheltenham Twp., where the larvae have been found on the grass *Triodia flava*. The one seasonal brood flies in June and early July, with rarely a few in Cheltenham flying in August or early September. This partial second brood has not been noted at the Arboretum or elsewhere in the area.

Poanes hobomok, Golden Skipper (250)

In my original article I mentioned the absence of this species, and directly following its publication one turned up! A very worn male, it was taken on the very edge of area 3, in the ecotonal area joining area 2, on June 21, 1963. This species is rather local but where it breeds it is generally common. Despite diligent searching, no further specimens were found. The nearest breeding colony is in Chestnut Hill and about three miles away. It is possible that a strong-flying male could have strayed this far, but the matter is far from settled. The species definitely does not occur in the environments at the Arboretum where one would expect it — i.e., in areas 1c and 4. The larvae feed on marsh grasses.

It is worth noting that the very local species *Atrytonopsis hianna,* which had not been seen around Philadelphia for several years, was discovered in small numbers along the tracks of the Chestnut Hill Local trains about three miles from the Arboretum, in June-July, 1963. There is only one brood. Mention is made of the insect in case it should eventually turn up at or around the Arboretum grounds. It is common in the New Jersey "pine barrens".

Apart from the commoner Skippers, a few of the species that managed to lend a hint of stability to an otherwise very peculiar season were *Boloria toddii, Asterocampa celtis,* and *Phyciodes tharos,* all of which were quite normal. *Danaus plexippus* was in normal numbers but lingered much later in fall than usual. By October 27 it was still numerous, some two weeks later than normal, as warm, dry, hazy weather persisted; the arrival of a cold wave in early November ended this activity abruptly, but a few specimens were still to be seen as late as November 16. *Colias* were numerous right up until the first hard frost, November 3. The last *philodice* of the season at the Arboretum was taken in the morning on November 5, and *eurytheme "ariadne"* were numerous on November 10 and 16; the last seen at the Arboretum was a female, November 17. This was the last Arboretum butterfly of the season.

The Arboretum and the Mt. St. Joseph tract were utilized for work in the study of *Colias* behavior and population dynamics in the course of 1963. Material from these two localities was also

utilized by the author in genetic studies of *Lycaenopsis argiolus* and the Noctuid moth *Caenurgina erechtea/crassiuscula*. The author's thanks to Dr. John M. Fogg, Jr., for his kindness in making the Arboretum facilities available, and for reading and offering kindly criticism of this and my previous paper.

NOTE

In the previous paper[1] a number of outmoded botanical names were inadvertently used. These should be brought up-to-date as follows: for *Polygonum acre* read *P. punctatum;* for *Aster ericoides, A. pilosus.* The following Asters should be added to the list of food plants of *Phyciodes tharos* at the Arboretum: *A. simplex; A. pilosus* var. *demotus; A. lateriflorus;* the identification of *A. patens* is queried. It should also be noted that the plant cited on p. 8 as *Hieracium aurantiacum* may be the very similar *H. flagellare;* the identification was made on the basis of vegetative characters and positive identification cannot be made until such time as the plant blooms. The author is indebted to Dr. Edgar T. Wherry for calling these points to his attention.

[1] Morris Arb. Bull. 14: 8-14, 32-36. 1963.

The Specific Name of Beale's Mahonia

JOHN M. FOGG, JR.

In my account of "Winter Damage at the Arboretum" in an earlier issue of this Bulletin,[1] I referred to Beale's Mahonia as *Mahonia Bealii*. In adopting this spelling of the specific name I was following such authorities as Bailey (1928), Rehder (1949), and Blackburn (1952). Strangely enough, in Rehder's Manual (1940), although the name is so spelt in the index, it appears in the text (p. 225) as *M. Bealei.*

During the preparation of Dr. H. L. Li's article on "The Cultivated Mahonias", which was published in our September issue,[2] the discrepancy between these two spellings prompted an investigation into the pertinent literature and suggested the desirability of putting this brief statement on record.

Mahonia Bealei (Fort.) Carr. is based on *Berberis Bealei* Fortune, which was published in 1850 in the Gardeners' Chronicle.[3] Fortune's description follows: "An evergreen shrub 8-10 feet high. Leaves 12-18 inches long, pinnate (four pairs and an odd one) leaflets large, oblique and cordate at the base, odd one ovate and cordate, pointed and spiny, smooth of a shining green, and very like the English Holly. Flowers in terminal spikes, spikes about 12 in number, each 6-9 inches long, yellow. Fruit of a glaucous blue. Flowers in winter, Dec.-March. From the district of Hwuy-chow, China."

In a footnote the author adds, "Named in compliment to my friend Mr. Beale of Shanghae, in whose garden many of my finest plants have been preserved."

The International Rules of Botanical Nomenclature are explicit with regard the spelling of specific epithets which are derived from personal names. They state that when the name ends in a consonant the letters *ii* are added, e.g. *Wilsonii, Veitchii, Wrightii,* etc. (an exception is made in the case of names ending in *er,* in which case a single *i* is added, e.g., *Werneri*). When, however, the name ends in a vowel the Rules provide that a single *i* should be added; thus we have *Fortunei, Henryi* and *Bealei.*

Since the Rules further state that the original spelling of a name must be retained, unless it can be shown to be a typographical error, it is clear that the correct spelling of the plant in question is *Bealei.*

[1] Morris Arb. Bull. 14: 27. 1963.
[2] Morris Arb. Bull. 14: 43-50. 1963.
[3] Gard. Chron. 212. 1850.

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Associates' Corner

The Sound of Running Water

Few things lend such enchantment to a garden as the presence of water; be it a pond, a stream or a fountain. In this regard the Morris Arboretum is very happily endowed. For more than half a mile the winding, wooded reaches of the Wissahickon Creek form its western boundary and two lesser streams traverse its lowland acres. These running and sparkling waters naturally attract many varieties of birds and small animals.

One of the streams enters the grounds from the Hillcrest Avenue side, skirts the southern limits of the Azalea Meadow and empties into the Swan Pond with its Greek temple and tiny island, one of the most photogenic spots in the Arboretum.

As it exits from the Swan Pond, this rivulet courses through an area shaded by cucumber magnolias, swamp-bay, and yellow wood, past the log cabin, where Miss Morris used to serve tea to her friends of a summer afternoon, and under the wooden bridge usually designated as "The Junction", because here four roadways come together.

One day, pausing on this bridge, I was attracted by some splashing in the water. To my astonishment a small dark bird jumped off the rocks and slid under the water, continuing to swim submerged to the bank lower down, where it landed and gave a flick of its wings, as if to say "Look, Ma, no snorkle." It looked for all the world like the Water Ouzel, a bird which I have spent hours watching in its native haunts. Since, however, this species has never been reported from east of the Rockies, I am told that my Arboretum bird must have been a water thrush or a spotted sandpiper. I'm still not convinced!

Below this crossroads the streamlet drops musically over a series of miniature cascades through a section which in Spring is brightened by the blooms of thousands of narcissus, squills, snowdrops and grape hyacinths. A little farther along it wends its sinuous way through a grove of Dawn Redwoods or Metasequoias, which in autumn flame into a blaze of russet glory before dropping their leaves. Still further down, after skirting the incomparable Skinner collection of native Azaleas, our tributary delivers itself unto the broader reaches of the Wissahickon.

Another stream, of quite different origin, makes its advent along Stenton Avenue midway between Northwestern and Erdenheim Avenues and flows westward across the north meadow to discharge its load into the Wissahickon. Some times it gets too enthusiastic and spreads all over the meadow, after a heavy rain.

Along this stream is located a stone structure housing a large undershot wheel and a pump. From here, in days gone by, water was pumped nearly a quarter of mile up the north slope over the ridge and down into several fountains which graced the south slope. What a wonderful thing it would be if this water wheel, inactive for many years, could be repaired and made to turn again.

However, the South slope is not entirely devoid of running water. From beneath the wooden bridge near the giant Raisin Tree there issues a "spring" which trickles over a series of well-placed rocks, disappears underground and emerges as a cascade plunging into the first of Mr. Morris's Japanese Gardens, known affectionately as Jap. I. From here underground pipes conduct the water to a long trough known as the Spanish Fountain. Again the stream follows a subterranean course to reappear as a cascade billowing over an outcrop of boulders below the newly created Heath Garden. Once more it disappears below ground, only to reemerge in the second Japanese Garden (Jap. II) where it courses over a series of miniature waterfalls before entering the Swan Pond.

Finally, mention should be made of the fountain in the middle of the Rose Garden. The motif here is composed of cat-tail and lotus and the fine spray which issues from these aquatic plants, beautifully done in copper, splashes into a circular concrete basin.

The idea of this sound of liquid melody occurred to me this summer when my well went dry and the tracing of the Morris Arboretum water courses cheered me no end, even if they, too, were in a somewhat anaemic condition.

I suggest that you treasure this little guide and next Spring follow the freshets for yourself. There are even handy spots to play Pooh Sticks.

Marion W. Rivinus

Library Accessions

The following are among the items added to the Library during 1963:

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*Gift of Barbara H. Emerson
**Gift of Dr. Douglas Macfarlan
***Gift of Richard B. Chillas, Jr.
†Gift of Mrs. John W. Townsend
††Gift of Dr. H. L. Li

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The Arboretum is happy to welcome the following new Associates who have been enrolled since September 1963:

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